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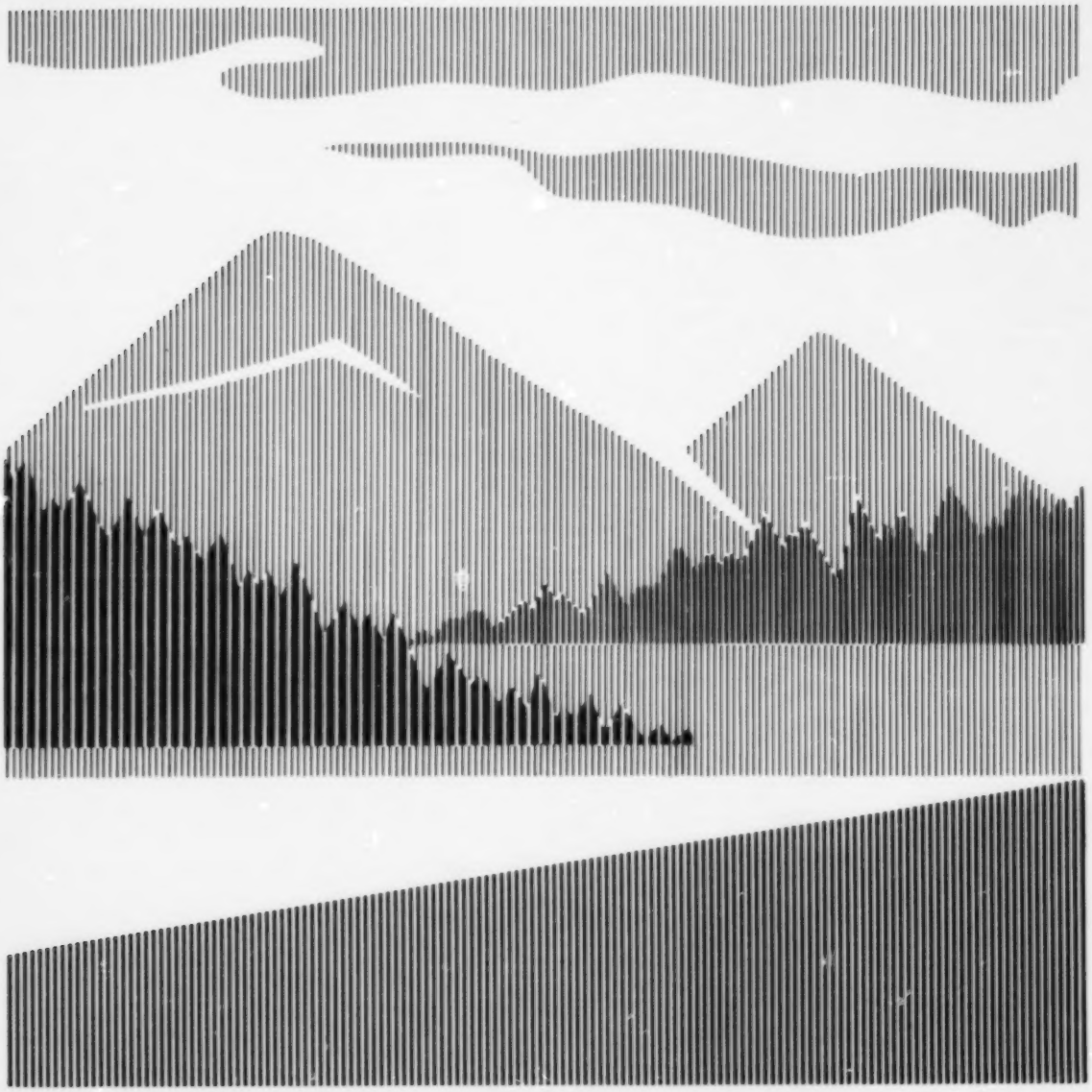
An Analysis of the Sawmill and Planing Mill Industry of Newfoundland

by Peter M. Trelawny

MARCH 1990



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by
Peter M. Trelawny

Newfoundland and Labrador Region

Forestry Canada

March, 1990

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Abstract

Approximately 2,100 sawmills and planing mills are licensed to produce lumber in Newfoundland, more than in any other province of Canada. However, 93 percent of the mills produce less than 100 Mfbm (thousand board feet) of lumber annually. Only 13 mills, less than one percent of the total mills, produce more than 500 Mfbm. The industry has performed poorly because of its highly balkanized structure. The technical and economic performance of the industry can only be improved through the consolidation of existing mills into larger, more efficient operations. Primary data, which were collected through personal interviews and mail surveys, provided the basis of this investigation.

Résumé

A Terre-Neuve, quelque 2 100 scieries et usines de rabotage possèdent des permis de production de bois de sciage, soit davantage que toute autre province canadienne. Cependant, 93% de ces entreprises produisent moins de 100 mpmp (milliers de pieds mesure de planche) de bois scié par an. Treize scieries seulement, moine d'un pour cent de l'ensemble, produisent plus de 500 mpmp. La structure morcelée de l'industrie provinciale explique sa faible productivité. Ce n'est qu'en intégrant les scieries actuelles en entreprises plus grandes et plus efficaces qu'on arrivera à améliorer le rendement technique et économique de l'industrie. Les données de base qui ont servi à cette enquête ont été recueillies par l'entremise d'entretiens personnels et d'enquêtes postales.

Executive Summary

In this report, the sawmill and planing mill industry of Newfoundland is analysed using the widely applied structure, conduct and performance methodology. The methodology is based on the premise that the structure of an industry influences the conduct of the operators of the firms within the industry. In turn, the conduct of operators is assumed to influence the performance of the industry.

Structure

Newfoundland's sawmill and planing mill industry fulfills most of the criteria to be classified as perfectly competitive. However, the local lumber industry does not fulfill the criteria of perfect competition concerning the unfettered mobility of firms and resources. Generally, smaller mills, producing less than 100 thousand board feet (Mfbm)[1] annually, have been freely allocated timber while larger mills, producing more than 100 Mfbm, have been denied sufficient harvesting rights because of a combination of political, sociological and historical factors. As a result, the province's lumber industry consists of numerous small, push-bench sawmills, and a limited number of larger sawmills and independent planing mills. Of the 1,401 licensed mills which operated in 1987, 1,297 mills or 93 percent produced less than 100 Mfbm of lumber. Only 13 sawmills, less than one percent of the total mills, produced more than 500 Mfbm of lumber.

Conduct

The conduct of the operators of sawmills and planing mills follows directly from the atomistic structure of the industry. An individual operator faces stiff competition from other manufacturers of lumber within the province and on the mainland. Over the past two decades, approximately 60 percent of the lumber consumed in Newfoundland was imported. As a consequence, the operators of mills in the province are price-takers, facing a horizontal or completely elastic demand schedule.

Imports are particularly significant in the broader widths, larger thicknesses, and longer lengths of dimension lumber and boards because of a chronic shortage of large diameter sawlogs in Newfoundland. The large sawmills (> 500 Mfbm) are the marginal producers of dimension lumber in the province. Sawmills on the mainland are the marginal source of dimension lumber and boards of longer lengths and larger dimensions.

The elderly age and lack of schooling of operators are factors inhibiting the transfer of new technology to the lumber industry in the province. Apparently, younger, more schooled decision-makers and entrepreneurs have been attracted to other activities because of poor returns to the manufacturing of lumber.

Performance

Clearly, the economic performance of larger mills (> 100 Mfbm) is superior to the performance of smaller mills (< 100 Mfbm) because larger mills benefit from lower capital costs. However, the technical performance of all mills, regardless of size, is poor, especially with respect to the recovery of by-products. The proportion of by-products that are recovered is substantially less in Newfoundland than in most other provinces. The poor recovery of by-products is a major constraint to the expansion of the local lumber industry.

In 1987, the lumber industry of Newfoundland shipped $25.1 million of lumber and other products; contributed $14.3 million to the provincial economy; and provided 751 person years of direct employment, according to data gathered through a survey conducted by Forestry Canada. Also, in excess of 2,100 individuals received at least part of their income from working in sawmills, planing mills or associated logging operations. However, the long-term, economic contribution of the industry to the economy of the province could be increased significantly if the economic and technical performance of the industry was improved.

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[1] A fbm measures 1"x12"x12". Approximately 13 Mfbm of lumber is required to construct a detached, three bedroom house sided with wood.

Conclusions and Recommendations

The performance of the sawmill and planing mill industry of Newfoundland can only be improved through the implementation by the provincial government of a clearly articulated program designed to develop the industry. The program should include four measures.

First, stumpage charges should be levied on the volume of merchantable, standing timber to encourage greater use of timber and recovery of by-products. Currently, stumpage charges are levied on the volume of lumber produced.

Second, a comprehensive program of technology transfer should be initiated. The program should be targeted at the younger operators of mills to ensure efficient and effective results.

Third, the allocation of timber resources between the sawmill industry and the pulp and paper industry should be more highly integrated. For example, the provincial government could, following the example of the government of Quebec, require that the pulp and paper firms purchase the pulpwood and by-products of local sawmills before purchasing pulpwood from contractors operating on Crown Land.

Fourth and most importantly, the provincial government should encourage the consolidation of smaller mills into more efficient, larger operations in those areas of the province where the timber resource permits. Simply, the supply of timber is not sufficient to support the number of mills currently operating in Newfoundland.

If the provincial government fails to implement a program designed to develop the industry, the future of the industry will be bleak. In the absence of an effective program, many local producers will find it increasingly difficult to compete against mills on the mainland which are generally far more efficient. As a consequence, the returns to the manufacturing of lumber in Newfoundland will dwindle. Eventually, the low returns will force some operators of local mills to seek employment elsewhere and discourage other individuals from entering the industry. Inevitably, the lumber industry on the island of Newfoundland will wither if prompt action is not taken.

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CHAPTER I

Introduction

The manufacturing of lumber has been a vital element of the economy of rural Newfoundland since settlement was first permitted on the island in the early nineteenth century. Traditionally, the sawmill and planing mill industry[1] has provided lumber for the construction of homes, boats, wharves, stages, flakes and fences in the numerous, tiny outports which dot the coast of the island. Currently, the sawmill and planing mill industry generates valuable income and employment in rural areas of the province where alternative sources of income and employment are scarce. In addition, the industry provides diversity to an economy overly dependent on fishing.

Objectives and Purpose of the Report

The objectives of the report are twofold. The first objective is to analyse both technical and economic aspects of Newfoundland's sawmill and planing mill industry. The second objective is to identify problems within the industry and offer solutions.

The purpose of the analysis is to assist public agencies and private firms or organizations in developing the industry. The public agencies include the Department of Forestry and Agriculture (DFA), Department of Development and Tourism (DDT) and Newfoundland and Labrador Development Corporation (NLDC) of the provincial government, and the Atlantic Canada Opportunities Agency (ACOA) and Forestry Canada (ForCan) of the federal government. The private firms or organizations include the individual mills which comprise the industry, the Newfoundland Lumber Producers' Association (NLPA) and the various firms which supply or derive goods and services to or from the industry, such as equipment dealers, lumber wholesalers, building supply centres and insurance companies.

The report is required because very few studies have attempted to analyze the industry in the past. Furthermore, of the few previous studies, most have been limited by a lack of data (for example Hull and Mensinkai 1979; Gray 1980). Moreover, the previous studies are now outdated. The reference period of the most recent study on the industry is 1981 (Milne 1984).

Scope of the Report

The scope of the report is extensive. Numerous economic and technical aspects of the sawmill and planing mill industry are analyzed both between mills for a single year and over time for the entire industry.

Although the scope of the report is extensive, several restrictions have been placed on it. First, the analysis of regional differences within the industry is limited because local mills differ primarily in size and technology, as opposed to location. Second, the report focuses predominately on mills located on the island of Newfoundland, as opposed to Labrador, because the island is the major area of sawmilling activity in the province.

Finally, every endeavor has been made to produce a report that is readily understandable by a wide group of individuals with diverse backgrounds and training. Hopefully, the general reader finds the methodology and the style of writing to be straightforward.

Outline of the Report

The report is divided into six chapters. In the following chapter, the methodology of the report is outlined, and the primary and secondary sources of data are noted. In the third, fourth and fifth chapters, the results of the analysis are presented. In the sixth and final chapter, conclusions are drawn and the future prospects of the industry are discussed. The appendices, located at the end of the report, provide more detailed information. The executive summary, located at the beginning of the report, contains the highlights of the analysis.

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[1] The sawmill and planing mill industry includes establishments primarily engaged in the manufacturing of lumber from roundwood (Standard industrial classification number 2512). The terms "sawmill and planing mill industry" and "lumber industry" are used synonymously throughout this report.

CHAPTER II

Methodology and Data

Methodology

A systematic methodology is required to analyse an industry. In this report, the structure, conduct and performance (SCP) methodology is selected. This widely applied approach to industrial analysis was conceived by Edward Mason and, subsequently, popularized by numerous other individuals, most notably Joseph Bains (Bains 1968)[1]. The reasons for selecting the SCP framework are twofold. First, the framework does not require that the reader have a strong knowledge of microeconomic theory. Second, the framework provides a logical, orderly system for analyzing an industry.

The SCP trinity is based on the premise that the structure of an industry is determined by fundamental, exogenous conditions such as demand and supply relationships. The structure of an industry influences the conduct of firms which, in turn, influences their performance. Structure refers to those characteristics of an industry which determine the nature of competition and pricing. The primary characteristics are distribution of production, conditions of entry, product differentiation and industrial integration. Conduct refers to the actions taken by firms in response to structural characteristics. Performance refers to the aggregate results of the actions of firms. In this report, the principle aspects of performance are economic efficiency, technical efficiency and general economic effects, as measured by the value of shipments, value added and employment.

Data

The data used in this study are derived primarily from a survey of the operators of sawmills and planing mills in Newfoundland conducted by Forestry Canada during the summer and fall of 1988. The survey was undertaken because Statistics Canada does not provide suitable information on the province's sawmills and planing mills.

Although Statistics Canada annually enumerates the province's sawmills and planing mills through its *Census of Manufacturers* and publishes the results of the enumeration, the published information is inadequate for several reasons. First, the information is not timely. At least three years elapses before data for a particular reference year are published. For example, the reference period of the most recent information published by Statistics Canada on the mills in the province is 1986. Second, the information is not representative of the population of mills. The *Census of Manufacturers* neglects to survey the numerous small mills in the province. In 1986, Statistics Canada enumerated only 40 of the largest mills, ignoring the 1,485 smaller mills which also operated during the year. Third, the information includes only principal industrial statistics such as the value of purchased inputs, number of employees and value of shipments. This information is woefully meagre and incomplete for a detailed analysis of the industry.

The operators of mills were surveyed through a stratified, random sample. The population of sawmills was stratified into four muturally exclusive strata according to each mill's production of lumber in 1987. The fifth stratum was comprised of independent planing mills. The five strata are:

(i) *very small* sawmills, annual lumber production of 25 thousand board feet (Mfbm)[2] or less

(ii) *small* sawmills, annual lumber production of greater than 25 Mfbm and less than or equal to 100 Mfbm;

(iii) *medium* sawmills, annual lumber production of greater than 100 Mfbm and less than or equal to 500 Mfbm;

(iv) *large* sawmills[3], annual lumber production of greater than 500 Mfbm; and

(v) *independent* planing mills.

The stratified sample survey is described in greater detail in Appendix A.

Sources of primary data other than the survey of sawmills and planing mills include a census of the 77 firms which imported lumber into Newfoundland in 1988. The census was conducted by the Policy, Planning and Economics Section of Forestry Canada's Newfoundland and Labrador Regional Office during the summer of 1989. Unless stated otherwise, the data used in this report are derived from Forestry Canada's sample survey of sawmills and planing mills and census survey of lumber importers. A variety of secondary data are used throughout this report. The secondary data are derived largely from information published by Statistics Canada.

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[1] For a recent application of the SCP methodology, see Caves (1987).

[2] Imperial units are used in this report to measure the volume of lumber produced by mills, as in the common practice in the Canadian lumber industry. All other measurements are in metric units accompanied by imperial units in parentheses.

[3] The mills of this stratum are considered large only by local standards. The largest sawmill in Newfoundland would tend to be small relative to those located in most other provinces.

CHAPTER III

Structure

The structure of the sawmill and planing mill industry of Newfoundland is analysed in this chapter to provide information on the economic environment in which mills operate. As noted in the preceding chapter, the structure of the industry influences the conduct of mill operators and, in turn, the performance of their mills. The structure of the sawmill and planing mill industry is analysed with respect to its historical development, current structure, concentration of production, conditions of entry, level of industrial integration and degree of product differentiation.

Historical Development

Absent from the structure, conduct and performance framework is an explicit consideration of the historical development of an industry. However, history plays an important role in the understanding of an industry (Kreps and Spense 1985). Therefore, the framework is modified in this report to include a description of the historical development of the manufacturing of lumber in Newfoundland.

Pre-confederation Period, 1610 - 1948

The sawmill and planing mill industry of Newfoundland has a rich, varied history. The first sawmill in North America was established at Cupids, the initial English colony in the New World, near Conception Bay on the island of Newfoundland in 1610.[1] However, the mill failed and the industry was virtually non-existent for the next 200 years.

The industry did not experience a period of sustained growth until settlement was permitted on the island in the early nineteenth century. During the seventeenth and eighteenth centuries, settlement had been actively discouraged under British law because influential English fishing interests feared a resident population of Newfoundland fisherman would jeopardize their monopoly over the region's rich fishing resource (Bursey 1980). With the introduction of private ownership of land in 1811 and the repeal of anti-settlement laws in 1824, many coastal communities were established. Subsequently, numerous small sawmills powered by water-wheels were built near these coastal communities to provide lumber for the fisheries and the construction of homes. These early mills were predominately domestic enterprises. Large, commercial mills were not established in Newfoundland until the 1890s when the construction of the railroad from St. John's to Port aux Basques provided access to the white pine (*Pinus strobus* L.) forests in the interior of the island. The first large sawmill was constructed at Botwood in 1890 to produce white pine lumber for export to England. This steam-powered mill produced 45 Mfbm of lumber per day, a capacity equalled or surpassed by only two mills currently operating in Newfoundland.[2]

For the next two decades, the local sawmill industry flourished because of strong domestic demand following the great fire of 1892 in St. John's and, more importantly, strong foreign demand for white pine lumber. The introduction of steamships in the 1880s permitted white pine lumber to be profitability exported to Great Britain. In 1884, 55 mills operated in Newfoundland, producing 11.4 million fbm; in contrast, by the turn of the century, 195 mills produced 43.6 million fbm (Munro 1978). Between 1890 and 1900, sawmills of comparable size to the one at Botwood were established in the central region of Newfoundland at Glenwood, Millertown, Badger, Gambo and Norris Arm (Page *et al.* 1974). Other mills of significant size were established at Horwood, Point Leamington, Gander Bay, Clarke's Beach, Campbellton, Benton and Corner Brook during this period (Bursey 1980).

The volume of lumber exported from Newfoundland more than quadrupled between 1891 and 1901 (Table 3-1). However, the export boom was short-lived, spanning only three decades, because of a shortage of white pine timber of sufficient quality. The white pine forests largely comprised of mature and over-mature timber with a high proportion of defects. By 1910, the white pine lumber industry was in rapid decline and by 1925, exports of lumber from Newfoundland had virtually ceased.

White pine was the only species suitable for export. Shipping costs account for a large proportion of the total value of exported lumber because of the low price of wood relative to its mass and volume. Therefore, only white pine of extremely high quality could be profitably shipped across the Atlantic Ocean. The depletion of the white pine forests marked the end of Newfoundland's only, albeit brief, period as an exporter of lumber. Henceforth, Newfoundlanders have relied heavily on imported lumber to fulfill their lumber requirements.

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[1] The first sawmills in the United States were built at Jamestown, Virginia in 1625 and at Bernick, Maine in 1631 (Brown and Bethel 1966). The first sawmill on the Canadian mainland was established at Lunenburg Bay, Nova Scotia in 1632 (Department of Lands and Forests 1967).

[2] Currently, the largest sawmill in the province, Glenwood Forest Products, located in central Newfoundland, has a capacity of between 50 and 60 Mfbm per eight hour shift. The province's second largest sawmill, Canada Bay Lumber, located at Roddickton on the Northern Peninsula, is designed to produce between 40 and 50 Mfbm per eight hour shift.

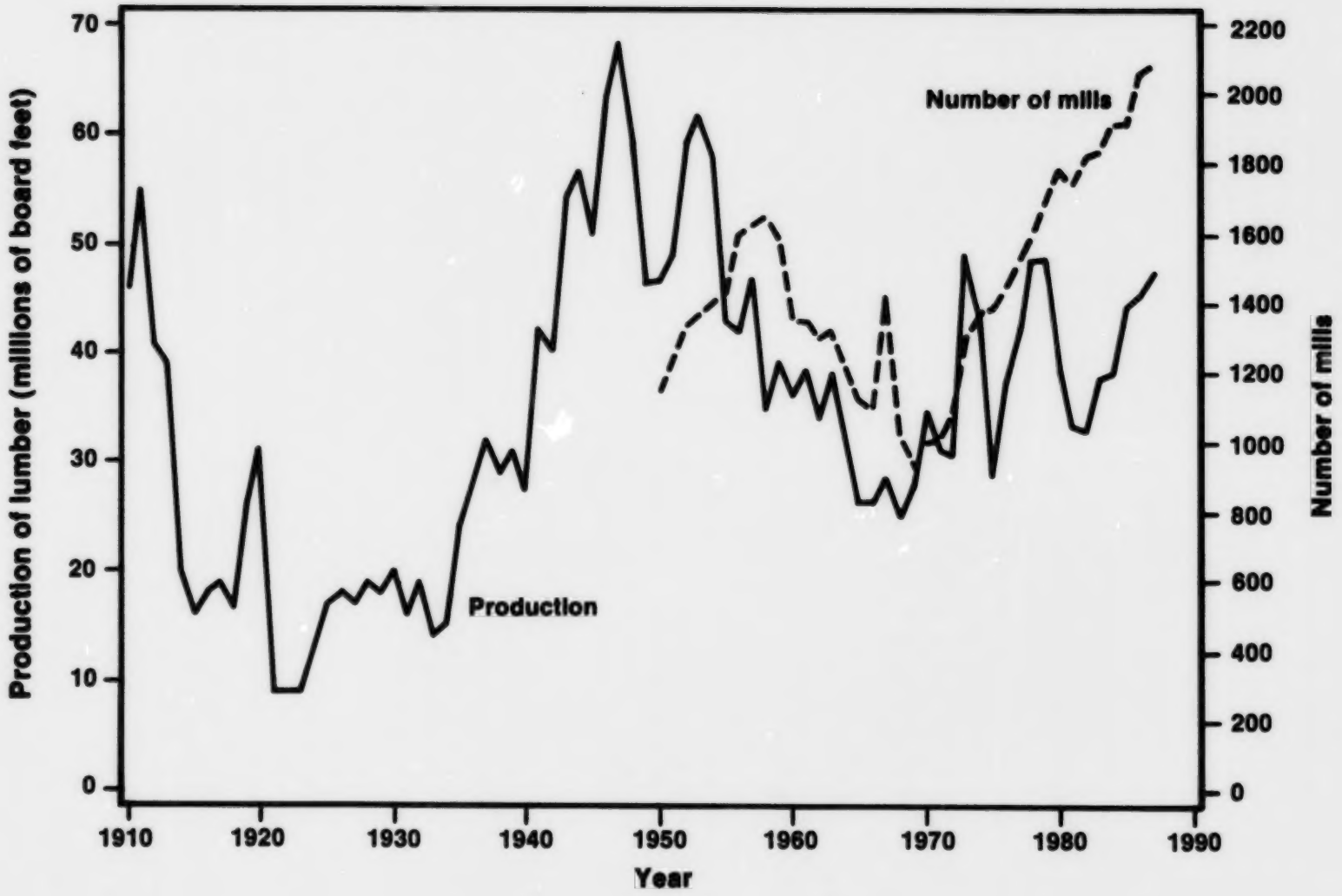


Figure 3-1 Production of lumber and number of sawmills and planing mills in Newfoundland, 1910-87

Table 3-1 Average, annual exports of lumber from Newfoundland, 1891 - 1925

Period	- Mfbm -
1891 - 95	2,909
1896 - 00	5,304
1901 - 05	13,164
1906 - 10	12,371
1911 - 15	2,267
1916 - 20	2,301
1921 - 25	1,174

Source: Munro (1978)

The annual production of lumber had dwindled to 8.8 million fbm per year by 1921 because of the demise of the white pine lumber industry and, in addition, the acquisition of sawmill timber licences by pulp and paper firms (Figure 3-1). The establishment of pulp and papermills, most notably the Anglo-Newfoundland Development Company's mill at Grand Falls in 1909 and the Newfoundland Power and Paper Company's mill at Corner Brook in 1925, led to the exclusion of sawmillers from access to the forests in the interior of the island (Munro 1978). By the 1920s, the only timber available to the lumber industry was located in the three-mile limit around the coast of the island[1], a few isolated areas in the interior of the island and remote regions of Labrador. The shortage of timber for sawing has impeded the development of the manufacturing of lumber to the present day.

The number of mills did not decline accordingly as production dropped in the early decades of this century. Instead, the number of mills increased as the large export-oriented operations were replaced by numerous smaller, primarily push-bench enterprises. For example, between 1911 and 1921, the number of mills doubled from 347 to 690. These smaller, labor-intensive mills processed black spruce (*Picea mariana* (Mill.) B.S.P.) and balsam fir (*Abies balsamea* (L.) Mill.) timber for local consumption instead of white pine timber for export.

Following the collapse of the export lumber industry and the establishment of the pulp and paper industry, lumber production did not exceed 30 million fbm until the early 1940s (Figure 3-1). During the Second World War and shortly thereafter, the production of lumber burgeoned because of the dramatic increase in military activity on the island. In 1947, approximately 1,600 mills operated in Newfoundland and production reached a record volume of 68.3 million fbm. However, this flourish of activity was followed by an era of gradual decline after Newfoundland joined Canada.

Post-confederation Period, 1949 - present

On December 11, 1948, representatives of Newfoundland and Canada signed the "Terms of Union" which established Newfoundland as Canada's tenth province. The "Terms of Union" led to the removal of tariffs between Newfoundland and the rest of Canada and the introduction of transportation subsidies. These two measures eventually permitted imported lumber from the Canadian mainland to capture a greater share of the local market. In 1951, 20 million fbm of lumber, 25 percent of provincial consumption, was imported (Newfoundland 1955).

By 1968, Newfoundland's dependency on imported lumber had grown to 45 million fbm, accounting for 64 percent of provincial consumption. Furthermore, at the time of Confederation, 1,148 sawmills operated in the province, producing 46.6 million fbm of lumber (Figure 3-1). By 1968, only 932 mills operated and annual production had dwindled to 25.1 million fbm, a post-Second World War low.

[1] Sometime between 1900 and 1905 the Government of Newfoundland prohibited the granting of licenses to cut timber on land within three miles of tidal water (Frost 1958). The purpose of reserving this land was to assure the timber needs of the fisheries and local communities were fulfilled (Griffin 1979). In 1979, government incorporated most of the area within the three-mile limit into forest management units. Since then, the provincial government has issued permits and restricted harvesting within the three-mile limit (Gray 1980).

Table 3-2 Structure of the sawmill and planning industry of Newfoundland, 1978 -87

Year	Stratum: Very small sawmills (0-25 Mfbm)	Small sawmills (25.1-100 Mfbm)	Intermediate sawmills (100.1-500Mfbm)	Large sawmills (>500 Mfbm)	Independent planning mills	Total
			number of mills			
1978	1,232	181	79	14	n.a.	1,506
1979	1,313	194	82	14	n.a.	1,603
1980	1,404	204	71	10	n.a.	1,689
1981	1,421	195	55	8	n.a.	1,679
1982	1,519	192	63	7	n.a.	1,781
1983	1,556	203	67	7	n.a.	1,833
1984	1,632[a] (420)	202	79	5	n.a.	1,918
1985	1,588 (381)	226	95	4	n.a.	1,913
1986	1,728 (572)	230	88	11	n.a.	2,057
1987	1,762 (686)	221	82	13	9	2,087
Percent change, 1978-87	43	22	4	-1		39

[a] The number of mills which did not operate or failed to file a sawmill return is in parentheses. Prior to 1984, mills which did not operate or failed to file a return were not recorded in a distinct category. Instead, these mills were included in the very small sawmill stratum.

Source: Department of Forestry and Agriculture, Government of Newfoundland and Labrador

The production of lumber in Newfoundland in the 1970s and 1980s followed the fluctuations in general economic activity in the province and the rest of North America (Figure 3-1). Production declined sharply in the mid-1970s as a result of severely depressed economic conditions throughout North America and then recovered strongly in the late 1970s as general economic conditions improved. The recession in the early 1980s caused another sharp drop in production. As with the North American economy, the production of lumber in Newfoundland has grown steadily during the mid- and late 1980s. However, the production of lumber has not yet recovered to equal the levels experienced in the late 1940s and early 1950s. In contrast, the production of lumber in the rest of Canada quadrupled from 6.5 to 25.6 billion fbm between 1950 and 1988 (Forestry Canada 1989).

In summary, the history of the lumber industry in Newfoundland has been characterized by protracted periods of modest production interrupted by two brief periods of frantic activity: (i) the export lumber boom at the turn of this century and (ii) the military construction boom during and shortly after the Second World War. Confederation contributed to a gradual decline in the production of lumber in the province. Only on several occasions in the past two decades has the production of lumber in Newfoundland recovered to approach the levels of the late 1940s and early 1950s.

Recent Structural Change

The number of sawmills and planing mills operating in Newfoundland has more than doubled in the past two decades. The number of sawmill licenses issued by the province's Department of Forestry and Agriculture (DFA) has increased from 932 in 1969 to 2,087 in 1987 (Figure 3-1). This increase is attributable to the proliferation of very small and, to a lesser extent, small sawmills. The number of very small sawmills, including those which did not operate or failed to file a return, and small sawmills has increased by 43 and 22 percent, respectively, over the past decade (second and third columns, Table 3-2). On the other hand, the number of intermediate and large sawmills has remained relatively unchanged during this period (fourth and fifth columns, Table 3-2).

The expansion in the number of very small and small sawmills is unexpected. Over time, a trend towards fewer, larger and more integrated enterprises should occur as an industry matures.[1] However, the consolidation of mills has been impeded by the chronic shortage of sawlogs. The timber has not been available to support the establishment of larger sawmills in most areas of the province with the exception of Labrador.[2]

[1] For example, in the other provinces of Canada, the number of sawmills and planing mills has declined from 1,839 in 1969 to 1,120 in 1986 (Statistics Canada cat. no. 25-202).

[2] Although the timber is available to establish a major sawmill in Labrador, one has not been established to date because of a number of problems such as the questionable quality of lumber produced from the region's predominate species, black spruce, the lack of infrastructure near Happy Valley - Goose Bay and the high proportion of pulpwood relative to sawlogs in most stands of the region.

Table 3-3 Geographical distribution of sawmills and planing mills of Newfoundland, 1987

Stratum	Region				
	Eastern (m.u. 1-3)[a]	Central (m.u. 4-13)	Western (m.u. 14-18)	Labrador (m.u. 19)	Total
Very small sawmills (1 - 25 Mfbm)	418	227	373	58	1,076
Small sawmills (25.1 - 100 Mfbm)	104	56	55	6	221
Intermediate sawmills (100.1 - 500 Mfbm)	25	32	24	1	82
Large sawmills (> 500 Mfbm)	1	9	3	—	13
Independent planing mills	6	2	1	—	9
Sub-total of mills which operated	554	326	456	65	1,401
D.n.o.[b]	115	62	112	10	299
D.n.r.[c]	227	87	73	0	387
Sub-total of mills which d.n.o. or d.n.r.	342	149	185	10	686
Total	896	475	641	75	2087

[a] Management unit
[b] Did not operate during 1987
[c] Did not report licensed production for 1987

Source: Department of Forestry and Agriculture, Government of Newfoundland and Labrador, 1987.

Table 3-4 Distribution of sawmills and lumber production in Newfoundland, 1987[a]

Stratum	Number of sawmills	Proportion of total sawmills	Lumber production	Proportion of total lumber	Average production per mill
		- Percent -	- Mfbm -	- Percent -	- Mfbm -
Very small sawmills (1 - 25 Mfbm)	1,076	77	6,212	13	5.8
Small sawmills (25.1 - 100 Mfbm)	221	16	11,256	24	50.9
Intermediate sawmills (100.1 - 500 Mfbm)	82	6	15,371	33	187.4
Large sawmills (> 500 Mfbm)	13	1	14,351	30	1,103.9
Total	1,392	100	47,190	100	33.9

[a] The lumber production of independent planing mills has been omitted to avoid recording their production twice. Planing mills merely resaw lumber previously recorded as the production of sawmills.

Source: Department of Forestry and Agriculture, Government of Newfoundland and Labrador.

Since Confederation, various Royal Commissions and Task Forces have recommended a reduction in the number of small, push-bench operations to increase the timber available to the larger, more efficient mills. The 1955 Royal Commission on Forestry recommended that new licenses not be issued and the transfer of existing licences be prohibited (Newfoundland 1955). The 1967 Royal Commission was highly critical, describing the smaller mills as "an archaic and wasteful independent industry, producing a crude product of doubtful real contribution to the provincial economy" (p. 163, Newfoundland 1967). The 1970 Royal Commission was equally as critical, "utilization at these small mills is poor, the product unmerchantable except for undemanding local use and, unless slabs and edgings are used for fuel, wastage is high" (p. 31, Newfoundland 1970). The Commission predicted the "gradual extinction" of the smaller mills in the province. Finally, the 1973 Federal-Provincial Task Force concluded that the small, push-bench mills were "extremely inefficient in terms of utilization of raw material and manpower. Lumber from the push-bench is often of low quality" and recommended the "gradual phase out of the push-bench mill as a commercial operation, with quality lumber production being encouraged in larger, more efficient mills" (p. 48, Newfoundland 1973). Despite these numerous recommendations, the number of small, push-bench mills has burgeoned in the past several decades.

Current Structure

Distribution of Mills by Size and Technology

In 1987, 2,087 sawmill licenses were issued by the Department of Forestry and Agriculture (sixth column, Table 3-3). Of the total licenses issued, 1,401 licenses were held by mills which operated during the year and filed a return. In total, 686 mills, approximately one-third of all licensed mills, either did not operate (299 mills) or failed to file a sawmill return (387 mills).

Very Small Sawmills

Of the 1,401 mills which operated in 1987, 1,076 mills or 77 percent were very small sawmills, each producing no more than 25 Mfbm of lumber (first row, Table 3-3). The 1,076 very small mills produced 6.2 million fbm of lumber, accounting for 13 percent of the total lumber produced in the province in 1987 (first row, Table 3-4). On average, 5.8 Mfbm of lumber was produced per very small mill.

Very small mills are divided into two categories: (i) domestic and (ii) commercial operations. Domestic mills do not sell their lumber; instead, their output is used solely to fulfill the personal requirements of their operators.[1] On the other hand, commercial mills market their lumber. Of the 1,076 very small mills which operated in 1987, 880 mills or 82 percent were domestic operations, producing on average 4 Mfbm of lumber per mill. In general, the 196 commercial mills of this stratum were larger than their domestic counterparts, producing on average 12 Mfbm of lumber per mill.

Very small mills are either stationary or portable. Stationary and portable mills use similar sawing technology; however, stationary mills are covered by a structure, usually little more than a roof supported by timbers, or enclosed in a crude building.

These very small mills usually consist of a wooden, push-bench carriage which is propelled manually on wooden rollers. A single source of power drives an inserted-tooth, circular headsaw varying in diameter from 60 to 107 cm. The source of power is either a gasoline or diesel boat, truck or car engine, usually of ancient vintage. The circular saws are designed to process sawlogs with diameters of between 10 and 50 cm. The kerf of these saws is wide, ranging from 6 to 10 mm. In general, the opportunity cost of the capital employed in the push-bench mills, most of which is obsolete, is extremely low. Typically, these mills are locally built and operated by their owner.

The push-bench mills operate on a "multiple-pass" basis. A sawlog is clamped to the wooden carriage and then shoved manually through the circular headsaw numerous times until the sawlog is squared. The width of the lumber is regulated by a movable plate usually situated directly behind the saw. The operation of push-bench mills is highly labor-intensive.

Most of the lumber produced by these mills is used immediately as rough (unplaned), green (unseasoned) and ungraded lumber. The lumber is of questionable quality, often characterized by excessive wane. These mills are designed solely for the primary breakdown of sawlogs. Secondary processing equipment, such as resaws, edgers, trimmers and planers, are absent in virtually all of the mills of this stratum.

---

[1] As defined by the Department of Forestry and Agriculture, domestic mills manufacture less than 6 Mfbm of lumber annually for non-commercial, personal use. All mills which manufacture 6 Mfbm or more of lumber annually are classified as commercial operations regardless of whether their lumber is sold or used solely to fulfil the requirements of their operator. In this report, a mill is classified as a domestic operation if the operator sold his lumber, as recorded through the survey, regardless of the annual production of the mill.

The very small, push-bench mills operate sporadically during the year, on average less than one month in total. The mills function when their operators would otherwise be unemployed or during evenings and weekends when they are not working at their primary occupations. Frequently, the operators of very small mills shutdown their operation for extended periods; however, they rarely leave the industry permanently. Instead, they renew their licenses in anticipation of restarting their operation sometime in the future. The very simple technology and low capital costs of the push-bench mills permit their operators to easily enter into or exit from the industry.

Small Sawmills

The second most populous stratum consists of small sawmills, producing between 25 and 100 Mfbm of lumber per year. In total, 221 mills or 16 percent of the mills which operated in the province in 1987 were small mills (second row, Table 3-3). The 221 small mills produced 11.3 million fbm of lumber, accounting for 24 percent of the total production of lumber in the province in 1987 (second row, Table 3-4). On average, 51 Mfbm of lumber was produced per small mill.

Although a few of the mills of this stratum are equipped with powered-carriages, most are portable or stationary push-bench operations, as with the previous stratum of very small mills. The 221 small mills operate for approximately one month of the year in total, producing mostly rough, unseasoned and ungraded lumber to serve regional requirements or squares for further processing by the independent planing mills. Typically, the dimension of the squares vary from 76 by 76 mm (3 in.) to 152 by 152 mm (6 in.). The squares rarely exceed 3 meters in length.

As with the very small mill stratum, the owner of a small mill is usually the sawyer who conducts all mill operations with the aid of unpaid family labor. Most owners and employees of very small and small mills do not earn their entire income from sawing lumber. The operation of both very small and small mills complement a variety of other sources of income including, in descending order of magnitude, fishing, social assistance and construction.

Intermediate Sawmills

Of the 1,401 mills which operated in 1987, 82 sawmills or 6 percent were intermediate sawmills, producing between 100 and 500 Mfbm of lumber during the year (third row, Table 3-3). The 82 intermediate mills produced 15.4 million fbm of lumber, accounting for one-third of the total lumber produced in the province during the year (third row, Table 3-4). On average, a mill of this stratum produced 187 Mfbm of lumber.

The intermediate mills use a combination of equipment found in both small and large mills. Although some intermediate mills use the push-bench technology, the majority of operations employ a powered carriage and a large circular headsaw for the primary breakdown of sawlogs. The carriage is moved in multiple passes by a cable and pulley system. Most intermediate mills have an array of equipment for the secondary processing of lumber such as resaws, edgers, trimmers and planers.

Approximately one-half of the lumber produced by intermediate mills is dressed, but very little is graded. Frequently, these intermediate mills employ both family and hired labor. Once again, the lumber is not kiln dried. Kiln drying equipment is absent from virtually all sawmills and planing mills in the province.

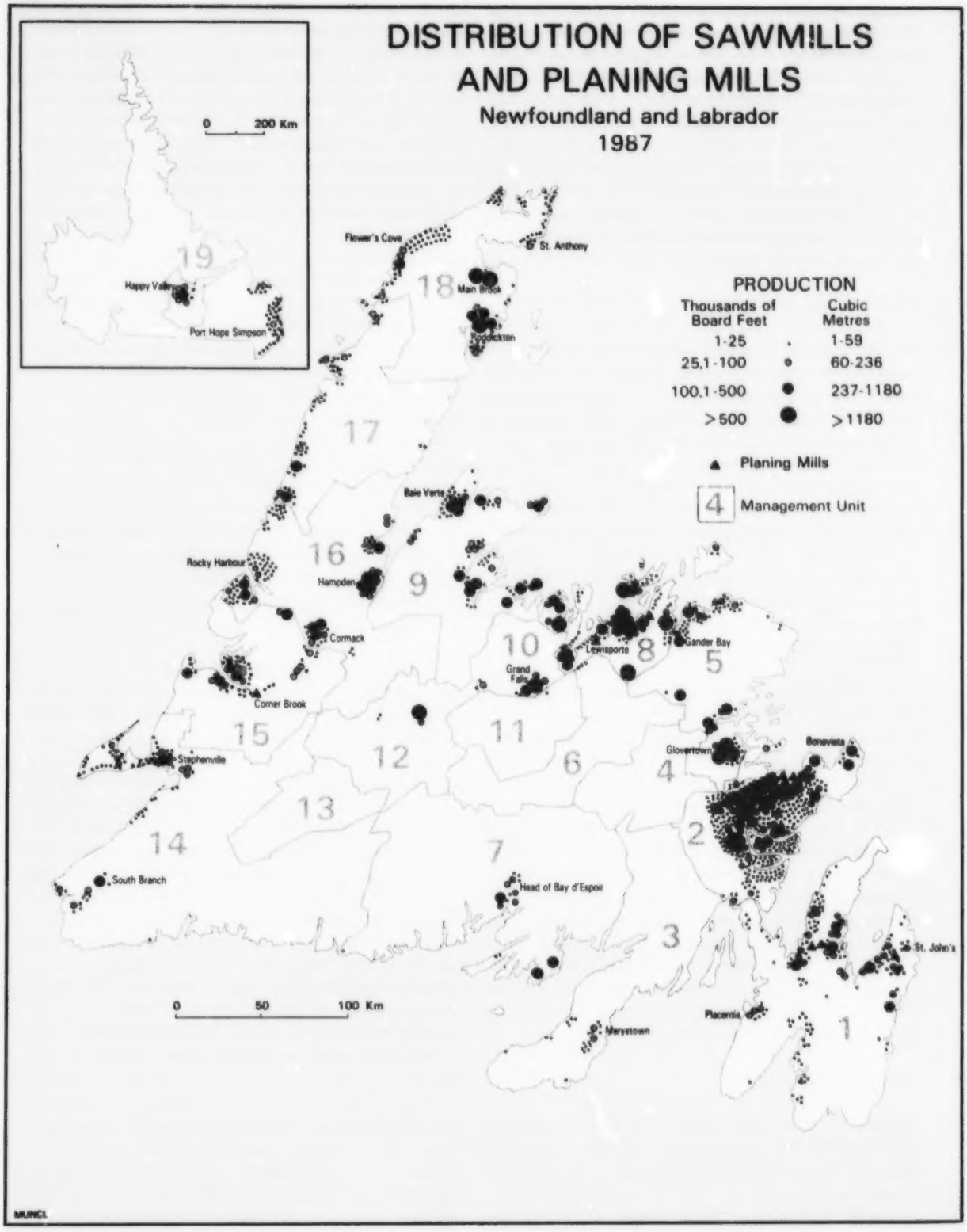
Large Sawmills

In 1987, only 13 mills, less than one percent of the mills in Newfoundland, were large sawmills, producing more than 500 Mfbm during the year (fourth row, Table 3-3). The 13 large mills produced 14.4 million fbm of lumber in 1987, accounting for 30 percent of the total lumber produced in the province (fourth row, Table 3-4). On average, a mill of this stratum produced 1.1 million fbm.

The technology used by the mills of this stratum is highly varied. As with the previous stratum, most large sawmills are simple portable or stationary operations housed in rudimentary structures. Of the 13 large mills, 11 mills consist of basic equipment, such as powered carriages, circular headsaws, resaws, edgers, trimmers and planers. On the other hand, the two other mills of this stratum, which are the largest operations in the province, employ highly automated, complex technology commonly found in mills of the major lumber producing regions of Canada. These two mills are designed to handle sawlogs on a rapid "one pass" basis rather than the "multiple pass" basis of the carriage system. The two mills use automatic infeeds, debarkers and multiple, circular saws for the primary breakdown of sawlogs into lumber. The lumber is further processed by a variety of other machinery, such as multiple-saw, gang edgers, resaws, trimmers and planers.

As with all the other strata, equipment that is designed to maximize lumber production and by-product recovery is not widely applied in large mills. Only three large mills have equipment to debark sawlogs and chip edgings, trimmings and slabs. Chipper headrigs are absent in Newfoundland. A chipper headrig was used in a large mill at Hawke's Bay in the 1970s; however, the

Figure 3 - 2


DISTRIBUTION OF SAWMILLS
AND PLANING MILLS
Newfoundland and Labrador
1987
0 200 Km
19
Happy Valley
Port Hope Simpson
Flower's Cove
St. Anthony
18
Main Brook
Roddickton
17
Baie Verte
16
Rocky Harbour
Hampden
9
Cormack
Corner Brook
10
Grand Falls
Lewisporte
8
Gander Bay
5
15
Stephenville
12
11
6
Glovertown
Bonavista
4
13
2
14
South Branch
7
Head of Bay d'Espoir
3
St. John's
Placentia
Marystown
1
0 50 100 Km
PRODUCTION
Thousands of Board Feet
Cubic Metres
1-25
1-59
25.1-100
60-236
100.1-500
237-1180
>500
>1180
Planing Mills
4 Management Unit
MUNCL

mill has since ceased operation. Electronic scanners and computers have not been adopted by the operators of local sawmills and planing mills for the manufacturing of lumber to date. However, microcomputers are used to assist in the administrative duties of several of the large sawmills and planing mills.

Independent Planing Mills

Independent planing mills purchase rough, sawn lumber or squares from the smaller sawmills and remanufacture them into dressed lumber. Nine independent planing mills operated in Newfoundland in 1987 (fifth row, Table 3-3). Total production per mill ranged from 92 to 5,100 Mfbm with an average of 1,482 Mfbm per mill.

The technology used by these mills varies greatly. All planing mills are stationary operations using a wide variety of previously owned equipment. Three of the nine planing mills are part of retail building supply centres. In general, planing mills that are affiliated with building supply centres are smaller, producing on average 525 Mfbm of mostly dimension lumber annually, than unaffiliated planing mills.

The independent planing mills are vital to the existence of the very small and small sawmills. Planing mills provide a readily accessible market for the output of the smaller sawmills, most of whose owners lack sufficient funds to finance inventories of lumber over extended periods.

In summary, Newfoundland's lumber industry is comprised of a large number of small sawmills, producing less than 100 Mfbm of lumber per year; a limited number of larger sawmills, producing more than 100 Mfbm of lumber per year; and nine independent planing mills. Of the 1,401 mills which operated in 1987, 1,297 mills or 93 percent produced less than 100 Mfbm of lumber. In total, 880 mills, 63 percent of all mills, were very small, domestic operations, producing on average 4 Mfbm of lumber per mill. Only 13 sawmills, less than one percent of all mills, produced more than 500 Mfbm of lumber.

As expected, a direct relationship exists between the technical sophistication and the size of a mill. Most very small and small sawmills are simple push-bench operations, barely distinguishable from mills of half a century ago. The majority of intermediate and large sawmills use a "multiple pass" system consisting of a powered carriage and a circular headsaw. The system is complimented by an array of secondary processing equipment. Only the two largest mills in the province employ the rapid, linear "one pass" system commonly found in the major lumber producing regions on the mainland.

Geographical Distribution of Mills

As with technology, the geographical distribution of mills is highly varied in Newfoundland. The majority of the mills which operated in 1987 were located in the eastern region of the province, largely in management unit 2 on the Bonavista Peninsula (Figure 3-2; Figure 3-3). In fact, 25 percent of the mills which operated in the province during 1987 were located on the Bonavista Peninsula. However, the vast majority of these mills were very small, producing less than 25 Mfbm of lumber annually. The western region of the island had the next highest number of mills, followed by the central region and Labrador.

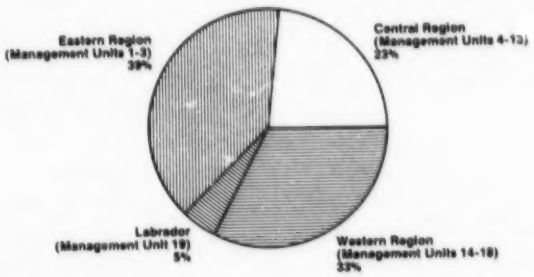


Figure 3-3 Regional distribution of sawmills and planing mills in Newfoundland, 1987

Most of the larger sawmills are located in the central region. In 1987, 40 percent of the intermediate sawmills and 70 percent of the large sawmills were located in central Newfoundland (third column, Table 3-3). Two-thirds of the independent planing mills were located in the eastern region, near the province's major market for dressed lumber, the St. John's - Mt. Pearl area.

Generally, sawmills are located near their primary source of sawlogs, productive forest land on unalienated Crown land in coastal areas on the island of Newfoundland, to minimize the distance sawlogs must be hauled (Figure 3-2). Very few mills are located in the interior of the island because most of the productive forest land of the interior is leased to the province's two pulp and paper firms, as noted previously. The two large sawmills, located in management units 10 and 12 in the interior of the island, harvest timber on the limits of Abitibi-Price Inc. under special arrangements with the pulp and paper firm.

Most mills are located in rural, sparsely populated areas on the island of Newfoundland far from the province's major centres of population. The highly dispersed

location of mills has led to poor public awareness of the sawmill and planing mill industry and posed difficulties for the development of cooperative organizations such as the Newfoundland Lumber Producers' Association.

Geographical Distribution of Production

Although the central region has approximately one-half the number of mills of the eastern region, it produces nearly twice as much lumber. In 1987, the central region accounted for 47 percent of the lumber produced in the province (Figure 3-4). The eastern and western regions each produced approximately one-quarter of the province's lumber. Although the forests of Labrador are a significant possible source of sawlogs in the future, currently, the production of lumber in the region is very low, accounting for less than 2 percent of the provincial total.

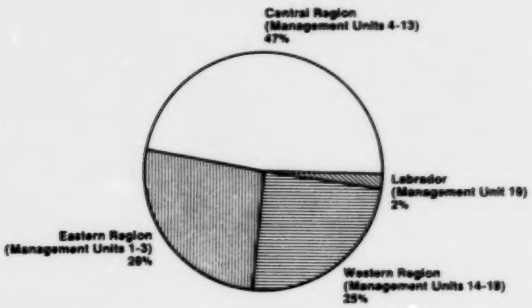


Figure 3-4 Regional distribution of the production of lumber in Newfoundland, 1987

In general, the management units with the largest area of productive, unalienated Crown land had the highest level of lumber production in 1987 (Figure 3-5). Management unit 8 produced more lumber than any other unit, accounting for 24 percent of the total lumber produced in the province. The unit has three of the four largest sawmills in the province. Management unit 2 had the second highest level of production followed by management units 18 and 9.

Concentration of Production

Traditionally, research in the field of industrial organization has focused on the concentration of production among firms within a common industry. Industrial organization researchers have associated a high level of concentration in production with a lack of competition and, as a consequence, an inefficient allocation of resources. On the other hand, a vigorously competitive industry is deemed to be efficient.

Numerous methods have been developed to measure the concentration of production in an industry (for examples, see Scherer 1980). Three of the most widely applied methods, Lorenz curve, concentration ratios and Herfindahl-Hirschman index, are used in this report. Although each method has its weaknesses, collectively, they yield a good understanding of the level of competition in an industry.

The Lorenz curve is an elementary method to analyse the distribution of a given parameter. In this report, the Lorenz curve is used to represent the distribution of lumber relative to the percentage of mills ranked in ascending size (Figure 3-6). The diagonal line represents an equal distribution of the production of lumber among mills. In other words, all mills are of identical size if the Lorenz curve coincides with the diagonal line. Generally, the more bowed the Lorenz curve, the higher the level of concentration.[1] The Lorenz curve of the sawmill industry of Newfoundland suggests the distribution of production is somewhat concentrated. For example, the largest 10 percent of the mills, numbering 139 in total, produced 70 percent of the lumber in 1987. However, the Lorenz curve measures only the relative, not the absolute, distribution of production.

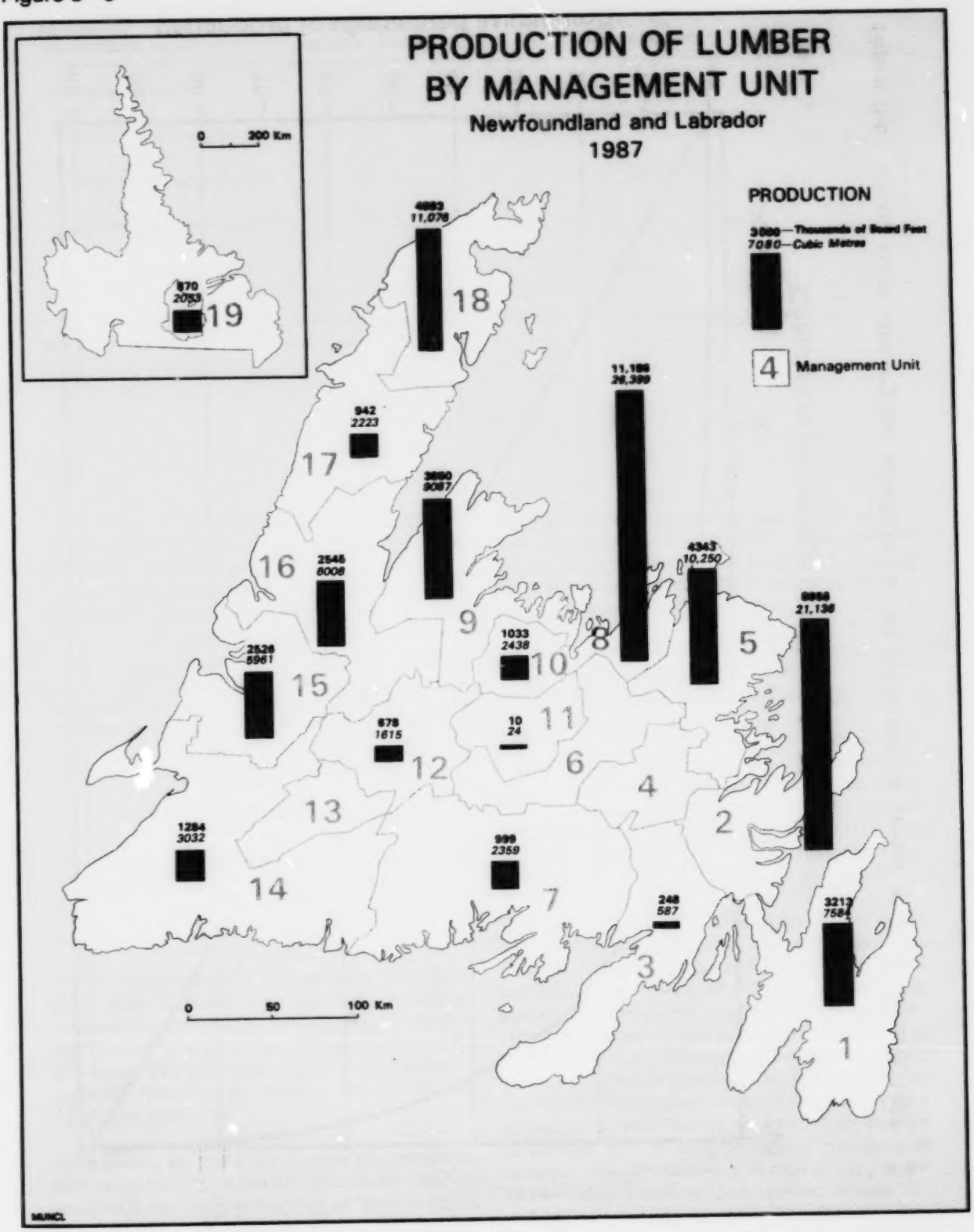
The concentration ratio combines both absolute and relative measures. The ratio is defined as the percent of some measure, such as production, sales or shipments, accounted for by an absolute number of the largest firms in an industry. Typically, concentration ratios are calculated for the 4, 8 and 20 largest firms in an industry.

In this report, concentration ratios are calculated for the 4, 8 and 20 largest sawmills based on the volume of lumber produced. The 4, 8 and 20 largest mills accounted for 17, 24 and 35 percent, respectively, of the production of lumber in Newfoundland in 1987 (Table 3-5).[2] However, these percentages exaggerate the concentration of production because they fail to reflect competition from the suppliers of lumber on the mainland. Imported lumber is a significant source of competition to producers of lumber in Newfoundland. Therefore, the concentration ratios are adjusted by combining provincial production with imported lumber. The concentration ratios, adjusted for imports, of the 4, 8 and 20 largest mills are 7, 10 and 15 percent respectively (Table 3-5)

[1] Conceivably, however, the distribution of a given parameter of an industry may be highly concentrated yet the Lorenz curve equals the diagonal line of equality, if the industry is comprised of only a few firms of equal size.

[2] In contrast, the 4, 8 and 20 largest sawmills in Canada accounted for 17, 29 and 49 percent, respectively, of the nation's total value of lumber shipments in 1987 (Statistics Canada 1988).

Figure 3 - 5


PRODUCTION OF LUMBER
BY MANAGEMENT UNIT
Newfoundland and Labrador
1987
PRODUCTION
3000—Thousands of Board Feet
7080—Cubic Metres
4 Management Unit
0 200 Km
0 50 100 Km
4883
11,078
18
870
2053
19
942
2223
17
3880
9087
16
2545
6008
2526
5961
15
9
1033
2438
10
8
11,188
26,389
4343
10,250
5
8956
21,138
11
10
24
678
1615
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2359
7
248
587
3
3213
7584
1
MUNCL

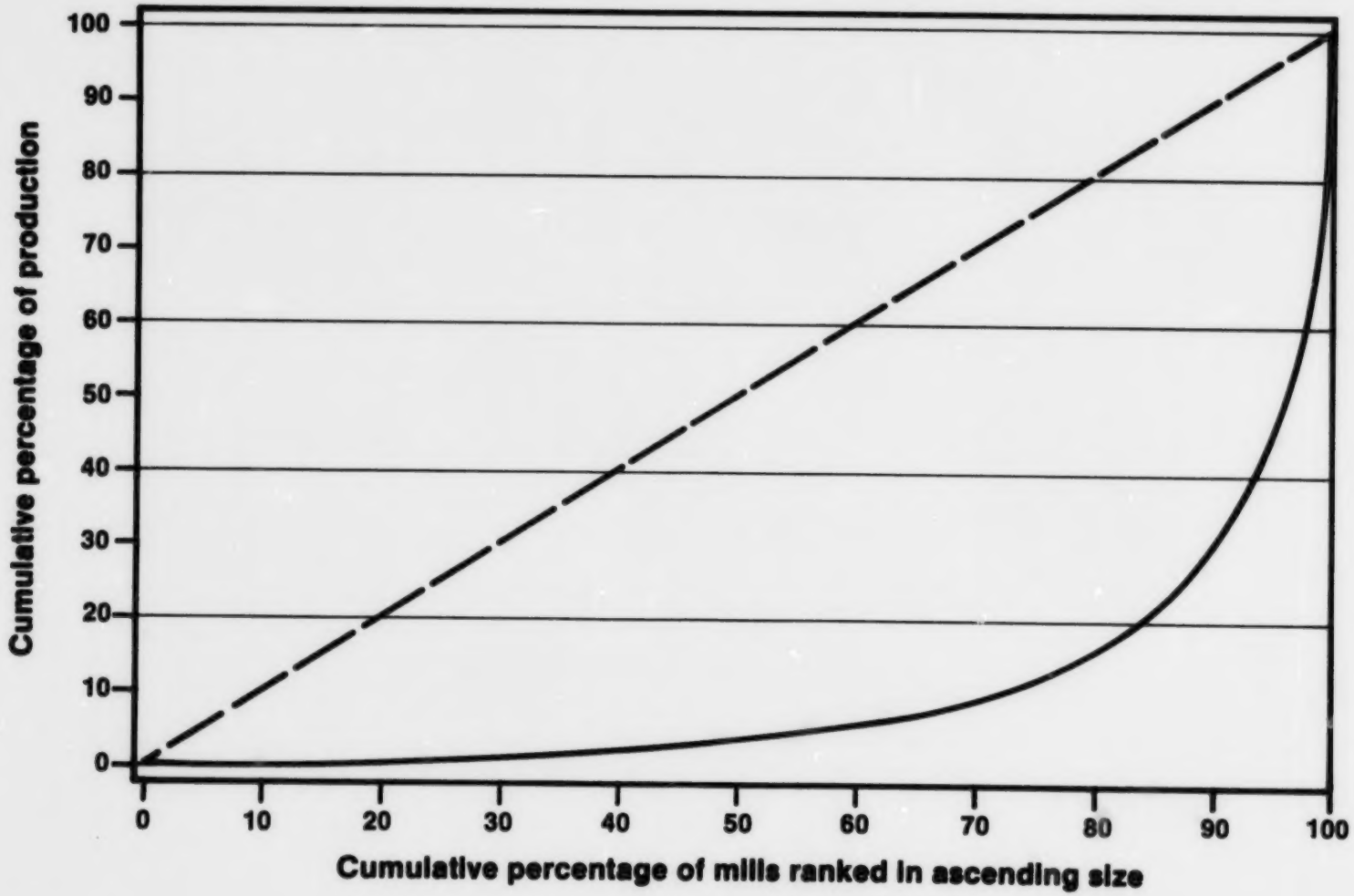


Figure 3-6 Lorenz curve showing the distribution of the production of lumber in Newfoundland, 1987

Table 3-5 Selected measures of concentration, unadjusted and adjusted for imported lumber, Newfoundland, 1987

Measure of concentration	Unadjusted for imported lumber	Adjusted for imported lumber [a]
Concentration ratios:		
Four largest sawmills (%)	17	7
Eight largest sawmills (%)	24	10
Twenty largest sawmills (%)	35	15
Herfindahl-Hirschman index	0.014	0.003

[a] Adjusted concentration measures are based on the total consumption of lumber, comprising of provincial production plus imports, in Newfoundland.

Another widely applied measure of the dispersion of production among firms is the Herfindahl-Hirschman (HH) index. The HH index is defined as the sum of the squares of each firm's output relative to the industry's total output. The value of the index declines with increases in the number of firms and increases with rising inequality among a given number of firms. In a purely competitive industry, the index would be approximately zero; on the other hand, under a monopoly the index would equal one.

In mathematical notation,

$$\text{Herfindahl - Hirschman index} = \sum_{i=1}^{n} (X_i T)^2$$

where X_i represents the volume of lumber produced by the i^{th} sawmill, T represents the total volume of lumber produced and n is the number of sawmills which operated in Newfoundland in 1987.

The HH index indicates that the production of lumber is highly dispersed (fourth row, Table 3-5). As with the concentration ratios, the HH index exaggerates the level aggregation by ignoring lumber imported from the mainland. The HH index, adjusted for imports, is markedly lower than the above, unadjusted measure (fourth row, Table 3-5).

In conclusion, the traditional measures of concentration used in this inquiry emphasize the atomistic structure and, hence, the competitive nature of Newfoundland's lumber industry. The province's lumber industry is highly competitive because of the large number of local mills and substitutes for local lumber. The substitutes include imported lumber and alternative building materials such as plywood, particleboard, cement, brick, gypsum, aluminum, steel and plastics.

Conditions of Entry: Timber Resource Barrier

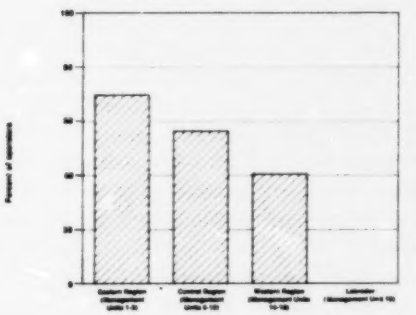
Another important characteristic of the structure of an industry are the impediments confronting prospective entrants. These impediments are commonly referred to by economists as barriers to entry. Barriers to entry are defined as costs or non-pecuniary obstacles confronting firms seeking to enter an industry, but not faced by established firms.

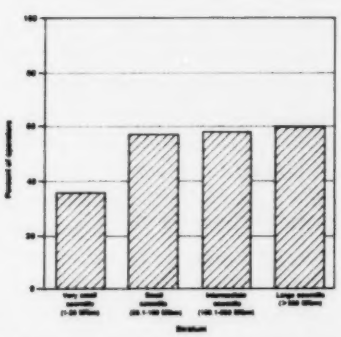
The conditions under which new firms are established influence the structure and, in turn, the conduct and performance of an industry. According to microeconomic theory, if potential entrants face significant impediments, established firms would be able to raise their selling price above their cost of production and, as a consequence, earn higher returns. Conversely, if new entrants are able to freely enter an industry, established firms would be forced to accept a selling price that merely covered their cost of production, thus ensuring an optimal allocation of resources. Possible sources of barriers to entry in the lumber industry include: (i) economies of scale; (ii) absolute cost barriers, which can be subdivided into capital costs and strategic factors, such as control of

production techniques via patents and special skills; and (iii) government policies and regulations, such as licenses limiting the supply of a strategic factor of production (Mead 1966).

Sawmills seeking to enter Newfoundland's lumber industry face few barriers. Economies of scale is not a significant factor limiting the entry of new mills. Also, minimal funds are required to construct or acquire an existing mill, especially a small, push-bench operation. Furthermore, incumbent mills do not control production techniques unavailable to new operations. The local lumber industry, as in other areas of Canada, has few patents or secrets. Machinery is frequently fabricated by local machinists or, in a very few of the large sawmills and independent planing mills, by millwrights. Successful innovations are easily reproduced by sawmillers or acquired from equipment manufacturers outside the province. In addition, local mills are able to readily update their production techniques through the acquisiton of used equipment from mills in the Maritime provinces and Quebec.

The only significant factor deterring the entry of new sawmills appears to be a shortage of a sufficient supply of sawlogs. Since the establishment of the pulp and paper industry in the early decades of this century, the local sawmill industry has been largely dependent on a diminishing supply of softwood sawlogs from unalienated Crown land in the coastal areas on the island of Newfoundland, as noted previously.





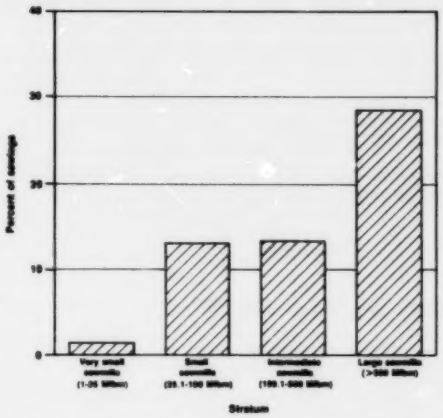


Figure 3-9 Proportion of sawlogs acquired from other cutters by sawmills in Newfoundland, 1987

Currently, 60 to 70 percent of the operators of sawmills on the island of Newfoundland are having difficulty acquiring an adequate volume of wood within a reasonable distance of their mill (Figure 3-7). As might be expected, the larger mills have greater difficulty than the smaller mills in securing timber (Figure 3-8). As a consequence, the larger mills acquire a greater proportion of their roundwood from other cutters (Figure 3-9). Operators of mills in Labrador have no difficulty acquiring an adequate volume of sawlogs within a reasonable distance of their mill (Figures 3-7).

In conclusion, potential operators seeking to enter the local industry, especially those wishing to establish smaller mills, face very few barriers. The only notable barrier is the shortage of timber suitable for sawing. Given the low level of concentration of production calculated in the previous section, this conclusion is not surprising. If the obstacles confronting possible entrants were substantial, fewer mills would operate and the production of the industry would be more highly concentrated. The low barriers to entry suggest that the operators of sawmills and planing mills in the province receive minimal profits and a low rate of return to their capital and labor. This hypothesis is more thoroughly investigated in the fifth chapter of this report, which deals with the performance of the industry.

Industrial Integration

According to traditional microeconomic analysis, three categories of industrial integration exist, vertical, horizontal and conglomerate. Vertical integration is defined as the coordination, under a single ownership, of two or more contiguous stages of production or distribution (Buzzel 1983). On one hand, vertical integration may be backward ("upstream") where firms undertake to produce raw materials that might otherwise be purchased from other firms (Scherer 1980). On the

Table 3-6 Proportion of sawmills and planing mills, which are backward vertically integrated, in selected provinces, various years

Type of operation	Newfoundland[a] (1-100 Mfbm)	Newfoundland[a] (> 100 Mfbm)	Manitoba[b]	Saskatchewan[c]	Alberta[d]	Yukon[e]
			- percent -			
Logging, sawing, and planing	11	34	49	41	35	41
Logging and sawing	47	43	45	57	63	29
Sub-total, logging sawing, and planing	58	77	94	98	98	70
Sawing and planing	3	21	2	—	1	18
Sawing only	39	2	4	2	1	12
Sub-total, sawing and planing	42	23	6	2	2	30
Total	100	100	100	100	100	100

Source: [a]Survey of the operators of sawmills and planing mills in Newfoundland, 1987, Newfoundland and Labrador Regional Office, Forestry Canada.

[b]Steele, T. W. and Williamson, T. B. (1989)

[c]Steele, T. W. Boylen, D. M. and Baumgartner, A. (1988)

[d]Ondro, W. J. and Williamson, T. B. (1982)

[e]Heartwell, C. (1988)

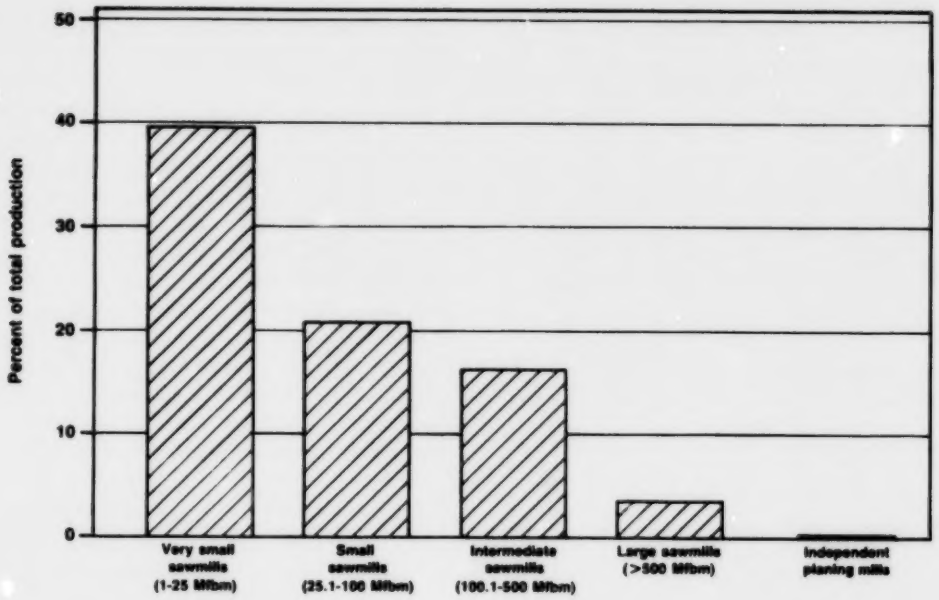


Figure 3-10 Custom sawing as a proportion of the total production of sawmills and planing mills in Newfoundland, 1987

other hand, vertical integration may be forward ("downstream") where firms either further process, wholesale, or retail products. Horizontal integration is defined as the single ownership of two or more production facilities producing similar products. Conglomerates involve a single firm owning enterprises in unrelated industries. Conglomerates are not present in the local lumber industry; therefore, they are not dealt with in this report.

Backward Vertical Integration

Backward vertical integration with logging operations appears not to be as widespread in the sawmill and planing mill industry of Newfoundland as in the other provinces of Canada for which comparable information is available (Table 3-6). For example, the sawmill and planing mill industries of Manitoba, Saskatchewan and Alberta are all more highly integrated than Newfoundland's sawmill and planing mill industry. In Newfoundland, the absence of vertical integration is especially noticeable amongst the smaller sawmills.

Logging Operations of Very Small and Small Sawmills

Only 58 percent of the sawmills with production less than 100 Mfbm have logging operations (Table 3-6). Instead, many of these smaller sawmills commonly operate by custom sawing logs cut and delivered by others for a fee or for a share of the lumber produced. For example, the operators of very small sawmills rely on custom sawing for 40 percent of their roundwood (Figure 3-10).

The logging operations of these predominately push-bench mills are relatively labor-intensive. Typically, the owner of the mill serves as both logger and mill operator with the aid of part-time hired or unpaid family labor. The logging equipment varies greatly between mills. Generally, the equipment is old and not designed for logging. The opportunity cost of the capital is extremely low. Chain saws are used to fell timber. A variety of vehicles, including hired or borrowed skidders, agricultural tractors, crawler tractors, all-terrain vehicles and, in winter, snowmobiles, are used to skid trees to the side of a road. Light trucks are used for hauling sawlogs from roadside to the mill. Frequently, these vehicles are used in other activities such as construction. Sawlogs are commonly harvested in conjunction with pulpwood and fuelwood.

Logging Operations of Intermediate and Large Sawmills

The larger sawmills are more vertically integrated than the smaller sawmills (Table 3-6). In total, 77 percent of the intermediate and large sawmills are combined with logging operations. Typically, mills are integrated with logging operations to ensure an adequate supply of timber for sawing and to reduce costs.[1]

[1] See Schwindt (1985) for a detailed analysis of the incentives for vertical integration of firms in the forest industry.

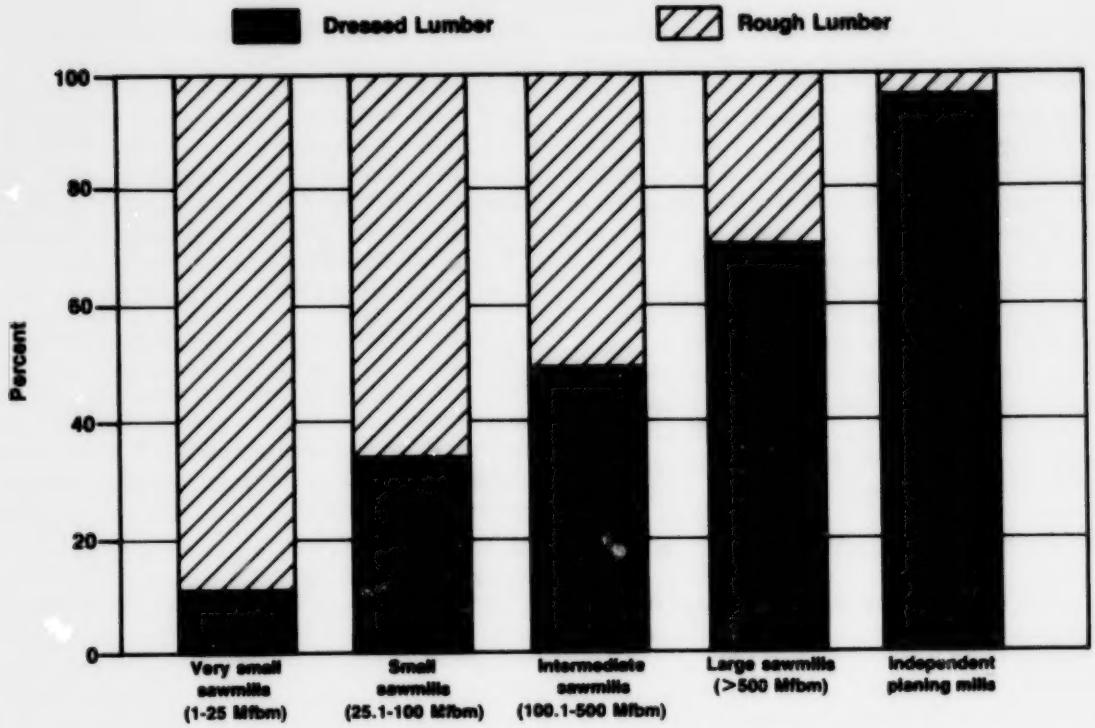


Figure 3-11 Production of dressed and rough lumber by sawmills and planing mills in Newfoundland, 1987

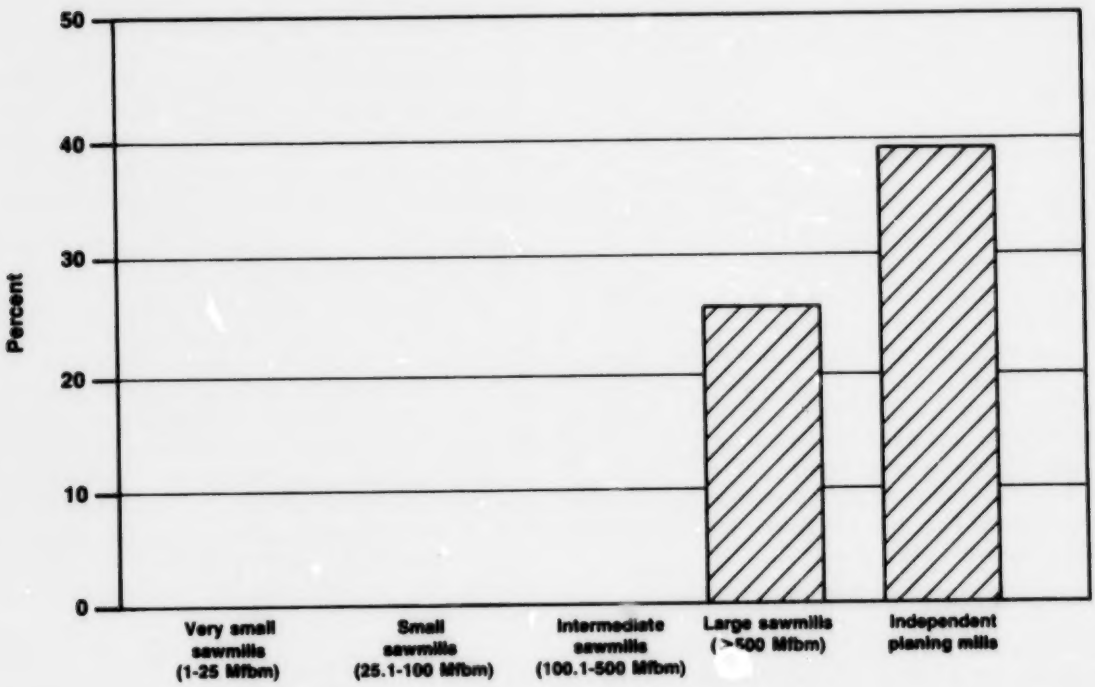


Figure 3-12 Production of grade stumped lumber by sawmills and planing mills in Newfoundland, 1987

The logging operations of the intermediate and large mills are conducted by woods employees of the sawmill, by employees who work in both the mill and the woods or by private contractors. Typically, a clear-cut tree-length logging system is used. Timber is felled manually with chain saws and delimbed but not bucked. The timber is then either skidded to the side of a road for transport to a stationary sawmill or skidded to a portable sawmill for immediate processing. If skidded to roadside, the timber is either trucked directly to a sawmill or bucked to sawlog lengths and then trucked to a sawmill. The distance from roadside to mill varies greatly. Forwarders are becoming more frequently used in place of skidders in the logging operations of the larger sawmills. Forwarders are well suited for transporting the small diameter timber so commonly harvested in Newfoundland.

Forward Vertical Integration

Forward vertical integration is not extensive in Newfoundland's sawmill and planing mill industry. Less than one percent of the commercial mills are combined with a wholesale or retail operation. Instead, the smaller sawmills produce for their own consumption and sell their surplus lumber to either planing mills for further processing or retail operations. The larger sawmills and planing mills sell their lumber either directly to the public from their yard or ship to wholesale or retail firms, such as building supply centres and hardware stores, in the province's towns and cities. Typically, sawmills and planing mills are unaffiliated with the firm to whom they sell their lumber.

Horizontal Integration

As with forward vertical integration, horizontal integration is not widespread. Virtually all owners of mills operate only a single mill. Apparently, the operation of two or more of mills is not beneficial. Furthermore, the sawmills and planing mills of Newfoundland are not highly integrated with pulp and paper mills as in other provinces. Local sawmills sell pulpwood to Abitibi-Price's newsprint mill at Stephenville, and pulpwood and sawmill residues to Abitibi-Price's other newsprint mill at Grand Falls. However, neither of the province's two pulp and paper firms, Abitibi-Price Inc. and Kruger Inc., manufacture lumber nor sell sawlogs to sawmills.

Product Differentiation

The final aspect of structure to be examined in this chapter is product differentiation. Product differentiation exists when buyers form different preferences among products which are close substitutes. Differentiation greatly expands the marketing options of a firm or industry. The existence of product differentiation is reflected in the elasticity of a demand curve. The more inelastic the demand curve, the greater is the ability of a firm or industry to raise its selling price above its average cost of production and thereby increase its profits. Consequently, product differentiation is not only a characteristic of structure, it is also a determinant of the conduct of producers, a subject examined in the following chapter.

The local sawmill and planing mill industry produces two basic commodities, rough[1] and dressed[2] softwood lumber. Virtually, all sawmills and planing mills in the province manufacture softwood lumber. Balsam fir and black spruce are the predominate species from which softwood lumber is manufactured. Only four sawmills manufacture hardwood lumber.

The rough, softwood lumber is either used by the operator to fulfill his personal requirements, sold to individuals for use near the mill or purchased by planing mills for further processing into dressed lumber. Generally, the smaller the mill the higher the proportion of its production is rough lumber as opposed to dressed lumber (Figure 3-11).

Of the lumber produced, 20 percent is graded. The larger the mill, the greater the likelihood that its dressed lumber is grade stamped (Figure 3-12). The very small, small and intermediate sawmills do not grade lumber. Lumber is graded under the supervision of the Newfoundland Lumber Producers' Association in accordance with the standards of the National Lumber Grades Association. The grading of local lumber increases its uniformity with imported lumber. Local lumber manufacturers do not edge-brand nor package their lumber to distinguish it from the lumber of other manufacturers within the province or on the mainland.

Softwood lumber manufactured in Newfoundland is seldom air-dried and, even less frequently, kiln-dried. Dehumidification kilns are used exclusively to dry hardwood lumber in the province. The local demand for kiln-dried, softwood lumber is not very significant. Although the National Housing Act states that all lumber used in buildings financed by the Canada Mortgage and Housing Corporation must be dried to a moisture content of not more than 19 percent, this regulation is seldom enforced in Newfoundland. As with locally produced softwood lumber, imported softwood lumber is seldom kiln-dried. In 1988, 12 percent of the softwood lumber imported into Newfoundland was kiln-dried.

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[1] Lumber that has been sawn but not edged, trimmed, or dressed.

[2] Lumber that has been sawn, edged , trimmed and dressed by running it through a planner.

In conclusion, lumber manufactured in Newfoundland, especially dressed lumber, is relatively undifferentiated from its major competitor, lumber of varying species imported from other Canadian provinces. Therefore, the marketing strategies available to local lumber producers are limited. The operators of local sawmills and planing mills must price their lumber competitively with imported lumber. In general, differentiation is only an important determinant of the structure of an industry with sophisticated durable goods, such as cameras and computers, not a relatively homogonous commodity, such as lumber. Furthermore, the strong similarities between local and imported lumber reduces the effectiveness of advertising local lumber.

Chapter Summary

Economists classify industries or markets as perfectly competitive, monopolistic or some variation in between these two extremes. Newfoundland's sawmill and planing industry fulfills most of the criteria to be classified as perfectly competitive. The number of participants is sufficiently large so that no individual is able to perceptively influence the price of inputs or outputs. Local producers are unable to affect the price of lumber because of stiff competition from imported lumber. Lumber is sufficiently homogonous so that the product of one mill is essentially a perfect substitute for that of another mill. Artificial restrictions on demand, supply or prices are absent. However, the local lumber industry does not fulfill the criteria of perfect competition concerning the unfettered mobility of firms and resources.

Although small sawmills (< 100 Mfbm) have been free to enter the industry, the establishment of large sawmills (> 100 Mfbm) has been restricted by a shortage of timber suitable for sawlogs on the island of Newfoundland. Generally, smaller mills have been freely allocated timber by the provincial government while larger mills have been denied sufficient harvesting rights. This biased allocation of timber has resulted in a highly balkanized industry with highly dispersed production. As a consequence, the province's lumber industry consists of numerous small, push-bench sawmills, a limited number of larger sawmills and independent planing mills. Of the 1,401 licensed mills which operated in 1987, 1,297 mills or 93 percent produced less than 100 Mfbm of lumber. Only 13 sawmills, less than one percent of all mills, produced more than 500 Mfbm of lumber.

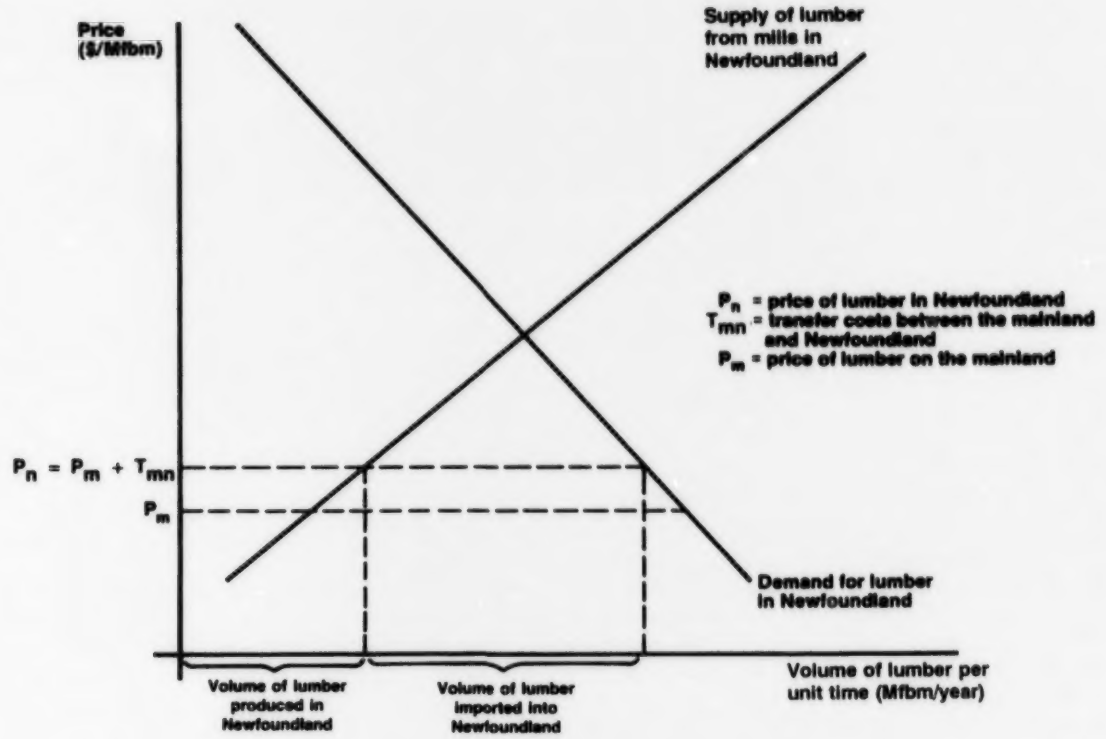
Price ($/Mfbm)
Supply of lumber from mills in Newfoundland
P_n = price of lumber in Newfoundland
T_{mn} = transfer costs between the mainland and Newfoundland
P_m = price of lumber on the mainland
$P_n = P_m + T_{mn}$
P_m
Demand for lumber in Newfoundland
Volume of lumber produced in Newfoundland
Volume of lumber imported into Newfoundland
Volume of lumber per unit time (Mfbm/year)

Figure 4-1 Demand, supply and imports of lumber in Newfoundland

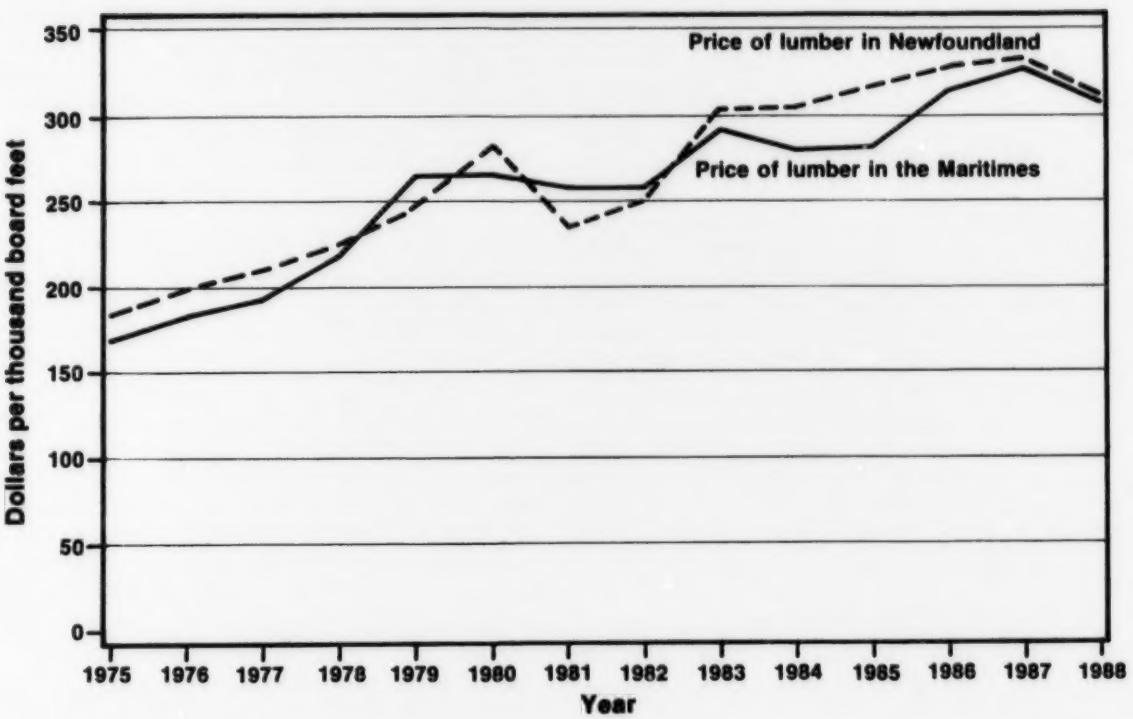

Figure 4-2 Price of lumber in Newfoundland and the Maritime provinces, 1975-88

CHAPTER IV

CONDUCT

The relationship between the structure of Newfoundland's lumber industry and the conduct of its operators is examined in this chapter. As was hypothesized in the previous chapter, the operators of local sawmills and planing mills are generally price-takers conducting business in a highly competitive industry. The primary objective of this chapter is to analyse the extent to which operators are price-takers and, more generally, the process by which the price of lumber is determined in Newfoundland. The secondary objective is to examine the managerial and sociological characteristics of operators which influence their conduct.

Pricing and Production of Lumber

The factors influencing the price of lumber are first identified in this section. The relationship between the price of lumber and the conduct of the operators of mills with respect to production is then examined empirically.

Spatial Pricing

The difference between the price of a traded good in different regions is determined largely by transfer costs under competitive conditions (Stigler and Sherwin 1985). Transfer costs comprise of transportation and transaction expenses. In Newfoundland, the price of lumber is determined largely by the cost of transferring lumber from the mainland to the province and the price of lumber on the mainland. In turn, the price of lumber on the mainland is determined by the demand for lumber, as derived from the retail level, and the marginal cost of production of mills throughout North America. In simple mathematical notation,

$$P_n = P_m + T_{mn}$$

where P_n and P_m are the prices of lumber in Newfoundland and on the mainland, respectively, and T_{mn} is the cost of transferring lumber to Newfoundland from the mainland (see Figure 4-1 for a graphical representation and Appendix B for a more detailed model). Transfer costs are fairly stable in the short term; therefore, any movement in P_m directly influences P_n.

Clearly, a direct, empirical relationship exists between the price of lumber in Newfoundland and the Maritime provinces, the origin of the majority of lumber which is imported into Newfoundland (Figure 4-2).[1] The Pearson's correlation coefficient[2] between the price of lumber in the two regions is 0.95.

Transfer costs offer local sawmillers protection from lumber imported from the mainland. In the near future, the level of protection should rise when federal government introduces the goods and services tax (GST). The GST, scheduled for implementation on January 1, 1991, will apply to the transportation of freight within Canada whereas its predecessor, the federal sales tax, applies only to manufactured goods and not to transportation services (Department of Finance 1989). Therefore, the GST will raise the cost of transporting lumber from the Canadian mainland to Newfoundland. The transportation of lumber from outside of Canada to Newfoundland will be exempt from the tax [3]. However, the volume of foreign lumber imported to Newfoundland is insignificant, comprising less than one percent of the total consumption of lumber in the province.

In the long term, the effects of introducing the GST will most likely be offset by lower costs of transportation because of improvements in the shipping facilities of Newfoundland and the Maritime provinces. Recent improvements in the shipping facilities linking Newfoundland and the Maritime provinces, such as the widespread use of containerized cargo, should continue in the future.

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[1] The prices used in Figure 4-2 and in the estimation of the correlation coefficient for the two regions are for different products. The Newfoundland price is for a composite of dressed lumber products (FOB, federal sales tax included) as derived from Forestry Canada's surveys of the operators of sawmills and planing mills in the province. On the other hand, the Maritime price is for 51 mm (2 in.) by 102 mm (4 in.) lumber of random lengths (SPF, FOB, federal sales tax included) as recorded by the Maritime Lumber Bureau (MLB various issues). Therefore, the margin between the two prices in Figure 4-2 does not represent the cost of transferring lumber between two regions.

[2] Correlation coefficients measure the degree of association between variables. The Pearson's product-moment correlation coefficient is the most widely applied measure of correlation. The Pearson's correlation coefficient, r, measures the linear relationship between variables over a range between positive and negative one. If r approaches positive one, the variables are directly related in a linear manner. On the other hand, if r approaches negative one, the variables are inversely related in a linear manner. If r equals zero, no linear relationship exists between the variables.

[3] The introduction of the GST is not expected to cause the substitution of lumber imported from outside of Canada, which will be exempt from the tax, for lumber imported from the Canadian mainland because of the high cost of transportation.

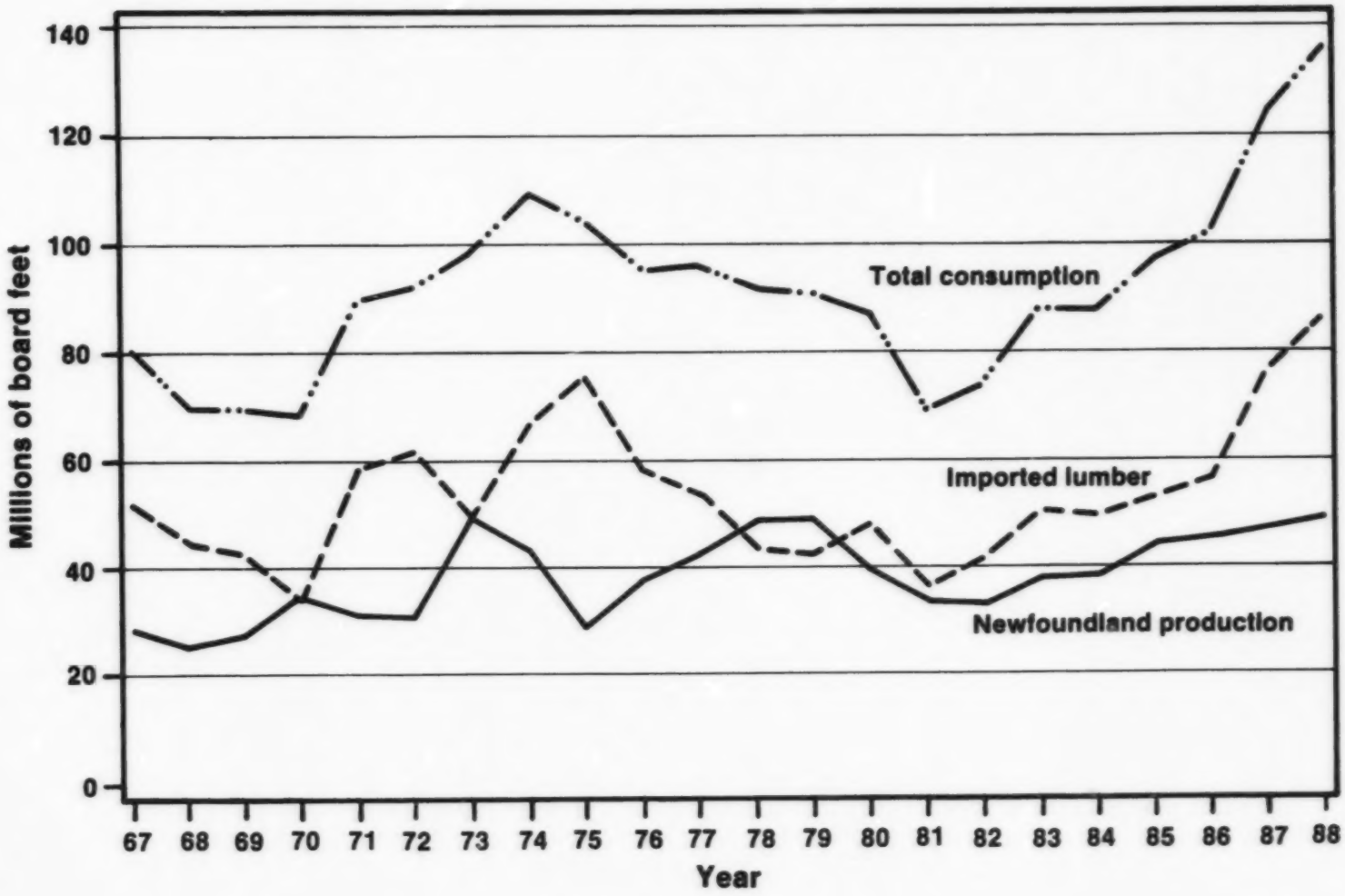

Figure 4-3 Production, imports and total consumption of lumber in Newfoundland, 1967-88

Imports of Lumber

The majority of the lumber consumed in Newfoundland is imported. On average 58 percent of the lumber consumed between 1967 and 1988 in the province was produced on the mainland (Figure 4-3 and Appendix C). Of the 136.1 million fbm of lumber consumed in the province in 1988, 86.9 million fbm was imported. The general shortage of sawlogs on the island has led to a heavy reliance by Newfoundlanders on lumber imported from the mainland.

The origin of the imported lumber is primarily New Brunswick, Nova Scotia and Quebec. To a lesser extent, lumber is imported from British Columbia, Ontario and Alberta. Less than one percent of the imported lumber is shipped from outside of Canada. Lumber is imported onto the island of Newfoundland by either tractor-trailers on public ferries operating between North Sydney and Port aux Basques or in containers on private vessels operating between Montreal or Halifax and St. John's or Corner Brook. In addition, small volumes of lumber are transported by rail from Quebec to Wabush in Labrador.

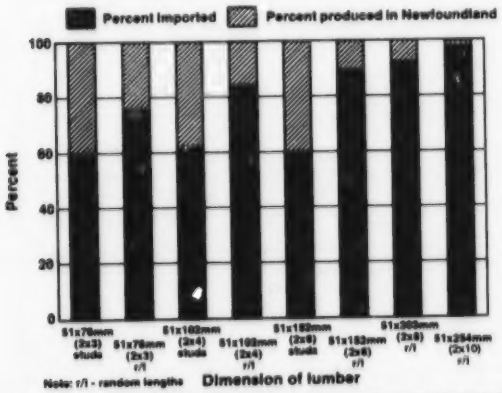

Figure 4-4 Percent of provincial consumption of lumber produced and imported into Newfoundland, 1988

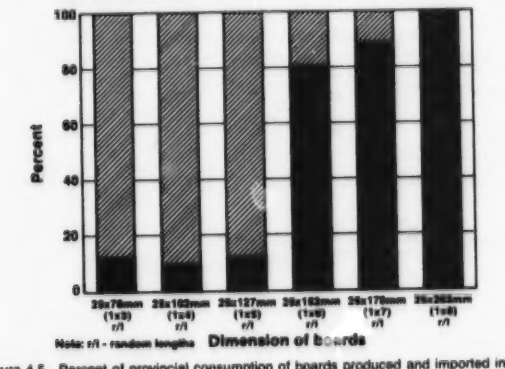

Figure 4-5 Percent of provincial consumption of boards produced and imported into Newfoundland, 1988

Generally, the proportion of dimension lumber and boards produced in Newfoundland relative to imports declines as dimension and length increases (Figures 4-4 and 4-5).[1] Imports are particularly significant in the broader widths, larger thicknesses, and longer lengths of dimension lumber and boards because of a shortage of large diameter sawlogs in Newfoundland. For example, in 1988, the proportion of studs imported was less than the proportion of longer random lengths for a given dimension.

Pricing Margins

A pricing or processing margin refers to the difference between prices of a product at different stages of manufacturing and marketing within an industry or across interdependent industries. In the sawmill and planing mill industry of Newfoundland, a margin is readily identifiable between the price of rough and dressed lumber (Figure 4-6 and Appendix D). In general the price of dressed lumber has been 40 percent greater than the price of rough lumber during the past decade in Newfoundland. A change in the price of dressed lumber on the mainland affects the price of dressed and, in turn, rough lumber in Newfoundland.

The strong correlation between the price of rough and dressed lumber provides further evidence of the highly competitive nature of Newfoundland's lumber industry. The nine independent planing mills, the major purchasers of rough lumber, do not appear to act as oligopsonists by offering less for rough lumber than would prevail under perfectly competitive conditions.[2] The operators of small sawmills, the major producers of rough lumber, benefit fully from any increase in the price of dressed lumber and, on the other hand, suffer fully the consequences of a decline in the price of dressed lumber.

Production of Lumber

The objective of this section is to analyse the behavior of the operators of local sawmills with respect to the production of lumber. The data are not available to analyse the production of independent planing mills over time; therefore, they have been excluded from the

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[1] Dimension lumber has a normal thickness of from 51 mm (two in.) up to, but not including, 127 mm (five in.) and a nominal width of 51 mm or more (Williston 1976). Boards have a nominal thickness of less than 51 mm and a width of 51 mm or more. The term "nominal" refers to the size by which lumber is sold; the nominal size often differs from the actual, dressed size.

[2] An oligoposonist is a member of an industry or market, referred to as an oligopsony, in which a small number of firms account for a large proportion of the demand for an input.

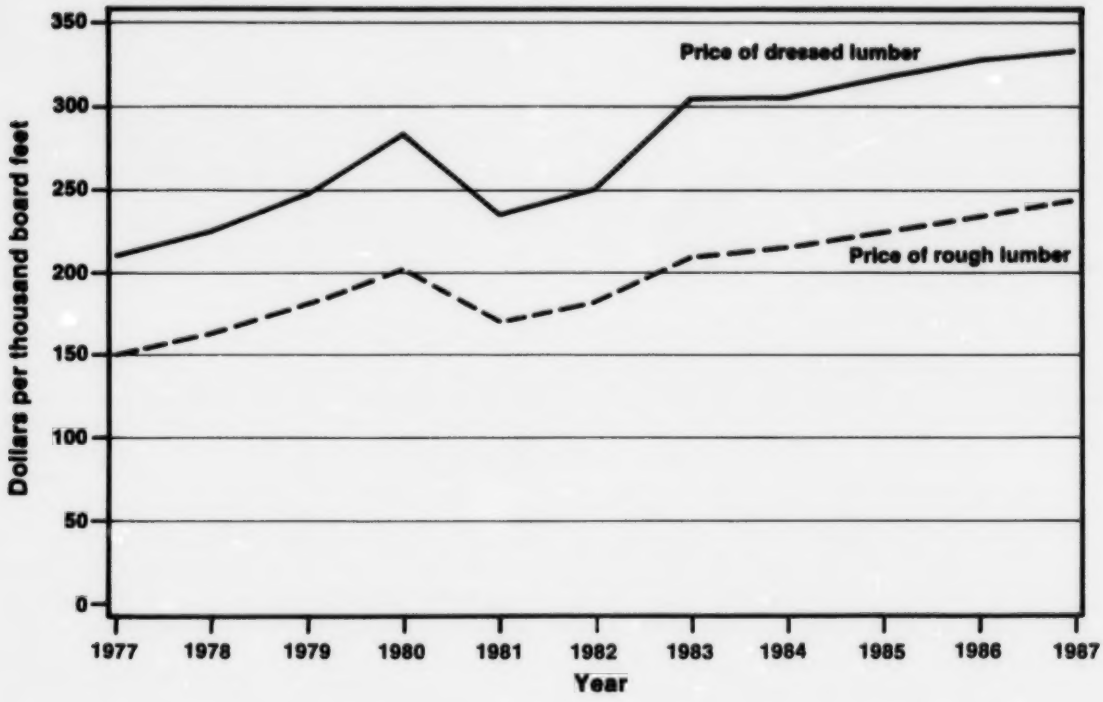

Figure 4-6 Price of rough and dressed lumber in Newfoundland, 1977-87

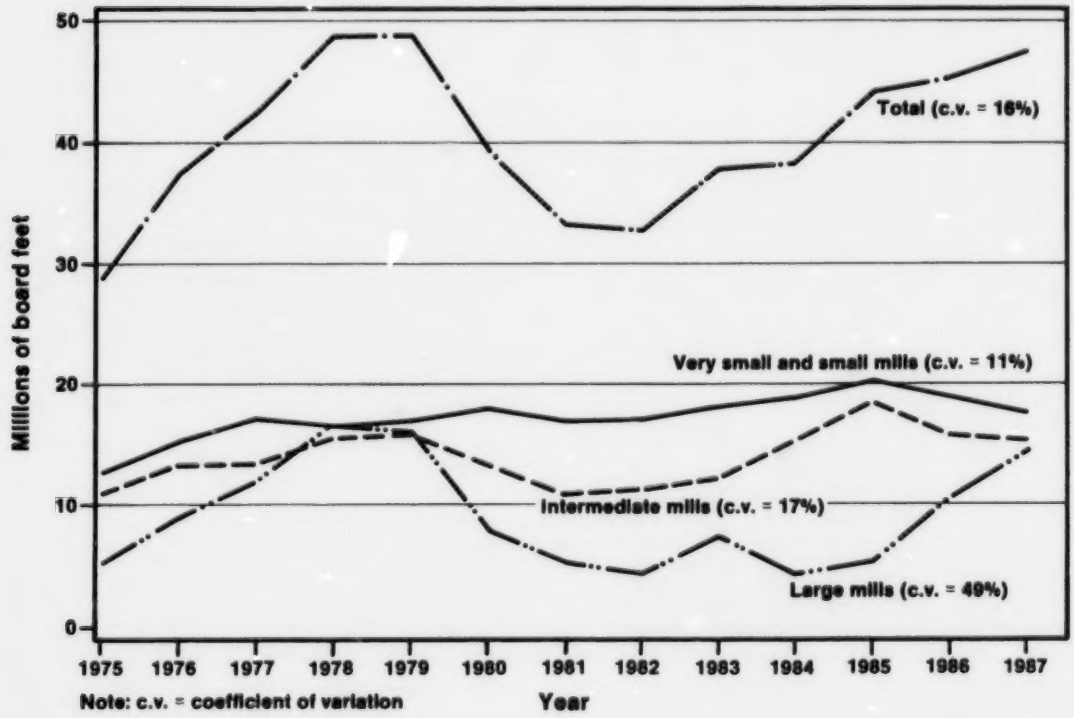

Figure 4-7 Production of lumber by size of sawmill in Newfoundland, 1975-87

Table 4-1 Type of ownership of sawmills and planing mills in Newfoundland, 1987

Stratum	Single proprietorship	Partnership	Corporation	Cooperative	Total
			- Percent -		
Very small sawmills (1 - 25 Mfbm)	75	24	1	0	100
Small sawmills (25.1 - 100 Mfbm)	77	10	12	1	100
Intermediate sawmills (100.1 - 500 Mfbm)	60	16	24	0	100
Large sawmills (> 500 Mfbm)	20	10	70	0	100
Independent planing mills	17	66	17	0	100
Weighted average[a]	74	21	5	0.1	100

[a] Weighted by the number of mills in each stratum.

Source: Survey of the operators of sawmills and planing mills in Newfoundland, 1987, Newfoundland and Labrador Regional Office, Forestry Canada.

Table 4-2 Managerial and sociological characteristics of the operators of sawmills and planing mills in Newfoundland, 1987

Stratum	Experience in the lumber iundustry	Ownership of mill	Age	Education
		— years —		
Very small sawmills (1 - 25 Mfbm)	16.3	14.4	51.2	8.8
Small sawmills (25.1 -100 Mfbm)	18.7	16.4	48.0	8.1
Intermediate sawmills (100.1 - 500 Mfbm)	20.5	17.2	49.0	8.2
Large sawmills (> 500 Mfbm)	16.0	13.5	45.0	9.7
Independent planing mills	23.8	23.0	46.7	9.8
Weighted average[a]	17.0	14.9	50.4	8.7
Provincial average[b] of adult males	n.a.	n.a.	34.5	10.7

[a] Weighted by the number of operators in each stratum.

[b] The provincial average is estimated for males, 15 years of age or older, who are members of the workforce (i.e. employed or seeking employment).

Source: Survey of the operators of sawmills and planing mills in Newfoundland, 1987, Newfoundland and Labrador Regional Office, Forestry Canada.
Statistics Canada, 1989b, Catalogue 71-001.

following analysis. Furthermore, the production of the very small sawmills has been combined with that of the small sawmills to extend the time series prior to 1979. Prior to 1979, the production of sawmills, producing less than 100 Mfbm annually, was combined in a single category in the only detailed records still available.

To achieve the above objective, the coefficient of variation, a relatively simple statistic, is used to examine the variability of the production of lumber between strata.[1] The coefficient of variation is selected because it is independent of a unit of measurement. Therefore, the coefficient of each stratum are comparable.

The coefficient of variation of the annual production of lumber between 1975 and 1987 of large, intermediate and small sawmills is 49, 17 and 11 percent, respectively (Figure 4-7 and Appendix E). Clearly, the large mills vary production more than the smaller mills in response to changes in general economic conditions. The large sawmills are the marginal or fringe producers of lumber in Newfoundland.[2]

When economic conditions in the industry improve, large mills expand production proportionately more than the smaller mills. On the other hand, when prices decline, large mills contract production proportionately more than the smaller mills.

The operators of the smaller mills are less sensitive to changes in the price of lumber than those of the larger mills because they are only concerned with covering their operating costs. Typically, their capital costs are minimal because their ancient equipment, vehicles and buildings are fully depreciated and have very low opportunity costs. Furthermore, their own labor has a very low opportunity cost.

The large sawmills are not the only marginal source of lumber. Sawmills on the Canadian mainland are another marginal source of lumber. In general, the large sawmills in Newfoundland are the marginal suppliers of small dimension lumber. Sawmills on the mainland are the marginal suppliers of dimension lumber and boards of larger dimensions and longer lengths.

Characteristics of Operators

The characteristics of the operators of local sawmills and planing mills influences their behavior or conduct. In this section, several of their major managerial and sociological characteristics are examined. The specific characteristics examined are the type and length of ownership and internal organization of mills, and the age, education and experience of their operators.

Type of Ownership

Newfoundland's sawmills and planing mills are owned exclusively by residents of the province. As to the legal form of ownership, single proprietorships prevail. In 1987, 74 percent of the mills were held by a single proprietor who usually served as both owner and operator, 22 percent were owned by partners and only 5 percent were incorporated (sixth row, Table 4-1). Complex ownership patterns, such as joint ventures, holding companies and partially owned subsidiaries, are rarely encountered.

A direct relationship exists between the complexity of the legal form of ownership and the level of production and sophistication of technology in the local lumber industry. As the capacity of mills increases and technology becomes more sophisticated, single proprietorships are replaced by partnerships and corporations. For example, one percent of the very small sawmills were operated as part of a limited liability corporation in 1987 (fourth column, Table 4-1). On the other hand, 70 percent of the large sawmills were incorporated. Many of the large sawmills and planing mills are operated through a partnership or incorporated for a variety of reasons, two of which are to provide capital and reduce taxes.

Internal Organization

The traditional form of internal organization of firms involving the division of personnel between labor, management and ownership seldom occurs even in Newfoundland's largest sawmills and planing mills. For example, owners of large mills are seldom separated from control of their mill. Instead, they actively participate in the management of their operation with very few exceptions. In addition, even the operators of the largest mills frequently labor in their mills when not performing management duties.

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[1] The coefficient of variation is defined as the standard deviation of a variable divided by its mean and expressed as a percentage. The standard deviation measures the extent to which a variable is dispersed about its mean or average value.

[2] Although beyond the scope of this report, regression analysis confirms the conclusion that the large sawmills are the marginal producers of lumber in Newfoundland. Regression analysis was used to examine the relationship between, on one hand, the production of lumber and, on the other hand, the price and cost of production of lumber in each stratum. The results of the regression analysis suggest that the relationship between the production of lumber, prices and costs becomes stronger, as indicated by the coefficient of determination and significance of the explanatory variables, as the size of the stratum increases.

Length of Ownership and Experience of Operators

On average, an operator of a sawmill or planing mill in Newfoundland has 17 years of experience in the lumber industry and has held title to his operation for 15 years (second and third columns, Table 4-2). The average experience of an operator exceeds the average length of ownership because an operator would have worked in another mill to gain the experience required to operate his or her own mill.

Generally, no significant correspondence is evident between experience, years of ownership and size of mills. The only significant trend observable is that the operators of planing mills have been involved in the lumber industry and owned their mill longer than sawmillers.

Age of Operators

The operators of sawmills and planing mills are elderly. Typically, the operator of a local mill was 50 years old in 1987 (fourth column, Table 4-2). In contrast, the average male member of Newfoundland's workforce, 15 years or older, was 34.5 years old in 1987 (Statistics Canada 1989b).

The elderly age of operators of mills presents a significant obstacle to programs of technology transfer. Generally, an inverse relationship exists between the age and the ability of an individual to adopt new technologies. To overcome this obstacle, programs of technology transfer should be targeted at younger operators, for example, the operators of large sawmills and independent planing mills, to ensure efficient and effective results.

Education of Operators

Typically, an operator of a local sawmill or planing mill in Newfoundland has less education than the general, adult population (fifth column, Table 4-2). In 1987, operators had 8.7 years of schooling on average, as opposed to 10.4 years for males 15 years or older in the province (Statistics Canada 1989b). In relative terms, the average level of schooling of operators was 16 percent less than non-operators. Apparently, younger, more schooled and skilled decision-makers and entrepreneurs have entered other activities.

In accordance with economic theory, the operators of large sawmills and planing mills tend to be more highly educated than those of smaller, less profitable mills (fifth column, Table 4-2). Generally, a direct relationship exists between schooling and the ability of an individual to adopt new technologies. Therefore, programs designed to transfer new technology to operators should be directed at the more highly educated individuals in the larger mills.

Chapter Summary

The conduct of the operators of sawmills and planing mills in Newfoundland follows directly from the structure of the industry. The industry is highly competitive. The operators face stiff competition from both local and mainland sources of lumber. As a consequence, the operators of mills in the province are price-takers, facing a horizontal or completely elastic demand curve for lumber.

The price of lumber in Newfoundland is determined by the cost of transferring lumber to the province and the price of lumber on the mainland. Despite the protection provided by the cost of transferring lumber to Newfoundland, the province is hardly self-sufficient in the production of lumber. Over the past two decades, approximately 60 percent of the lumber consumed in the province was imported, virtually all of which came from the Canadian mainland. Imports were particularly significant in the broader widths, larger thicknesses, and longer lengths of dimension lumber and boards because of an acute shortage of large diameter sawlogs in Newfoundland. The large sawmills (> 500 Mfbm) in the province are the marginal producers of dimension lumber. Sawmills on the mainland are the marginal source of dimension lumber and boards of longer lengths and larger dimensions.

The elderly age and lack of schooling of operators are factors inhibiting the transfer of new technology to the lumber industry in the province. Apparently, younger, more schooled decision-makers and entrepreneurs have been attracted to other activities presumably because of poor returns to the manufacturing of lumber. The returns to the manufacturing of lumber are examined in the following chapter.

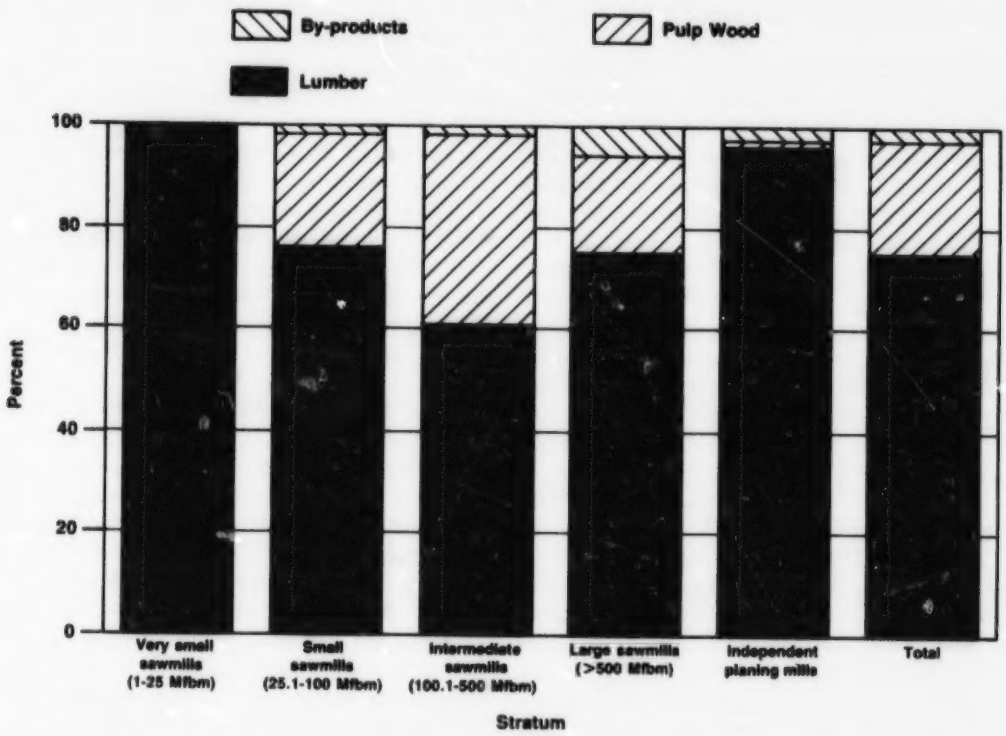

Figure 5-1 Sources of revenue in the sawmill and planing mill industry of Newfoundland, 1987

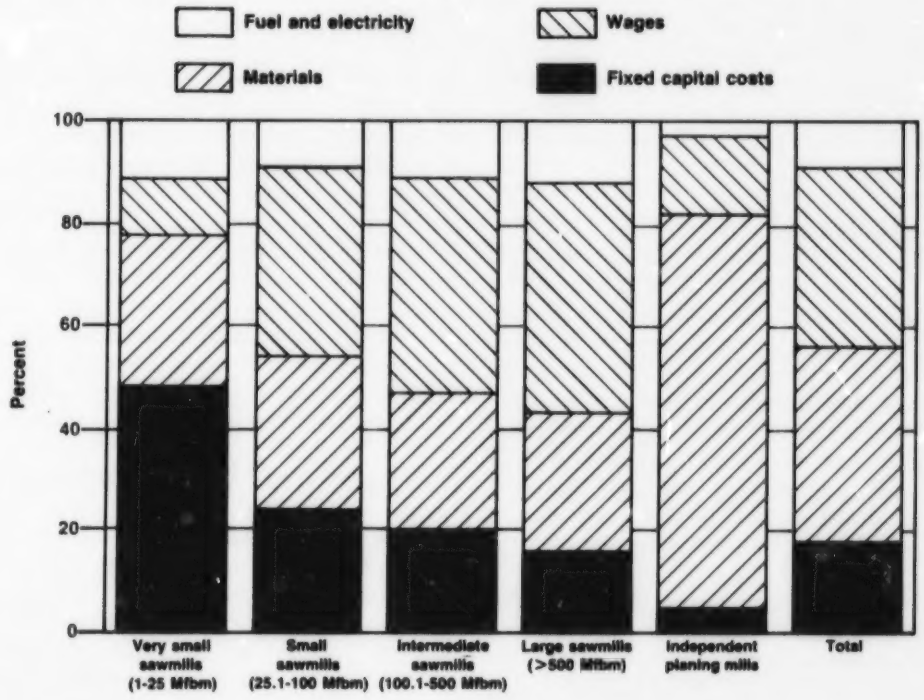

Figure 5-2 Distribution of operating and fixed capital costs in the sawmill and planing mill industry of Newfoundland, 1987

CHAPTER V

PERFORMANCE

Performance is concerned with the efficiency in which resources are used to produce goods and services within an industry. In this report, the performance of Newfoundland's sawmill and planing mill industry is appraised with respect to its economic efficiency, technical efficiency and economic impact using an inductive approach.

Economic Efficiency

A method of production is economically efficient if a given level of output cannot be produced at a lower cost or, conversely, if for a given level of cost more output cannot be produced. In this section, the two principal components of economic efficiency, output, as measured by revenue, and total costs, are first examined separately. Subsequently, the relationship between revenue and total costs is analyzed with respect to the size of mills and stumpage. Finally, comparisons are drawn between the economic efficiency of mills in Newfoundland and other Canadian provinces.

Revenue

Newfoundland's sawmills and planing mills derive revenue from the sale of rough and dressed lumber, pulpwood, and a limited volume of by-products such as pulpwood chips, planer shavings, sawdust, slabs, edgings and trimmings. Pulpwood chips are used as furnish in the manufacturing of newsprint. The other by-products are used as either commercial fuelwood or domestic firewood.

In 1987, the sale of rough or dressed lumber, pulpwood and by-products accounted for 75, 22 and 3 percent of the total revenue of the mills in the province, respectively (Figure 5-1). Pulpwood's share of revenue is proportionately larger in Newfoundland than in the major forestry regions of Canada because of the province's high proportion of small diameter timber and lack of technology designed to process small sawlogs.

A direct relationship exists between the size of sawmills and the diversity in the sources of revenue. As mills increase in size, the number of sources of revenue increases correspondingly. For example, the very small sawmills sold only lumber in 1987. In contrast, the large sawmills sold lumber, pulpwood and by-products.

Cost of Production

The operators of sawmills and planing mills incur operating (variable) and capital (fixed) costs in the manufacturing of lumber. The estimation of operating costs is very straightforward. Operating costs comprise of expenditures on items such as (i) fuel and electricity; (ii) hired labor; and (iii) materials, including roundwood and squares. On the other hand, the estimation of the cost of capital is far more difficult.

The term capital is vague, often having several meanings and methods of measurement. In this report, capital refers to the stock of durable goods, such as buildings, equipment and vehicles, that are not exhausted in a single year. Capital is measured at its replacement value. The replacement value is defined as the estimated cost of replacing the capital assets of a mill with similar items capable of supplying the same level of service. The cost of capital should reflect the flow of services from a given stock of capital and for a given period of time. Numerous approaches exist of varying complexity to measure these flows. In this report, a simple approach is applied where the annual cost of capital services is assumed to equal its rate of physical depreciation plus its expected, real rate of return or opportunity cost.[1] The procedure and data underlying the calculation of the cost of capital are described in greater detail in Appendix F.

Operating costs' share of total costs increases as the size of sawmills increases (Figure 5-2). Conversely, capital's share of total costs declines as the size of sawmills increases. The very small sawmills incur very high capital costs because of their tremendously under-utilized capacity.[2] In 1987, capital costs accounted for nearly one-half the total costs of the very small sawmills. On the other hand, capital costs accounted for only 16 percent of the total costs of the large sawmills.

The planing mills have very low capital costs, accounting for 5 percent of total costs, because they do not have logging operations. However, their low capital costs are offset by proportionally higher cost of materials. The materials of the planing mills largely comprise of squares and rough lumber purchased from other mills.

Generally, a direct relationship exists between the size of sawmills and the proportion of total costs attributable to hired labor (Figure 5-2). The very small sawmills are operated almost exclusively by the operator and unpaid family members without the aid of hired labor. In 1987, wages and salaries accounted for only 11 percent of the total costs of the very small sawmills.

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[1] The opportunity cost of a factor of production is the return it would earn if employed in its next best alternative.

[2] See page 38 for a discussion of the utilization of capacity in mills.

On the other hand, the operators of the large sawmills rely heavily on hired labor to harvest timber and manufacture lumber. In 1987, wages and salaries accounted for 45 percent of the total costs of the large mills.

Scale and Profitability

The ratio of total costs to gross revenue provides a convenient, nonparametric method for examining the relative profitability of local mills (Figure 5-3). The total costs in the numerator of the ratio comprise of operating (variable) costs and capital (fixed) costs, as defined in the previous section. A ratio of greater than unity (one) indicates a mill is operating unprofitability. Conversely, a ratio of less than unity indicates a mill is covering its total costs incurred in the acquisition of roundwood and the manufacturing of lumber. If the ratio equals unity, a mill is breaking even.

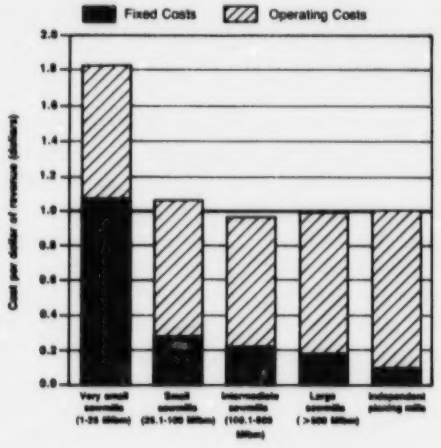


Figure 5-3 Total cost: revenue ratios of the sawmill and planing mill industry of Newfoundland, 1987

A comparison of cost:revenue ratios for each stratum indicates a wide variation in the economic performance of local mills (Figure 5-3). Clearly, the smaller operations (< 100 Mfbm) are less economically efficient than their larger counterparts. These smaller mills are viable only because their operators assign a lower opportunity cost and level of depreciation to their capital than has been applied in this report. Apparently, the ancient capital used by the very small and, to a lesser extent, the small mills has virtually no opportunity cost and is, in most cases, fully depreciated.

The intermediate and large sawmills, and independent planing mills are the most economically efficient mills in the province (Figure 5-3). The cost:revenue ratios of the mills of these strata are less than unity. The difference between the breakeven point of unity and the cost:revenue ratios of the mills of these strata represents the returns to the labor of the owners of the mills.

A further comparison of cost:revenue ratios suggests that strong economies of scale are evident at low levels of production followed by constant economies of scale at levels of production exceeding 100 Mfbm (Figure 5-3). For these larger sawmills, the economies of scale in sawmilling are offset by diseconomies of scales in harvesting a larger supply of logs drawn from farther afield (Gray 1980).

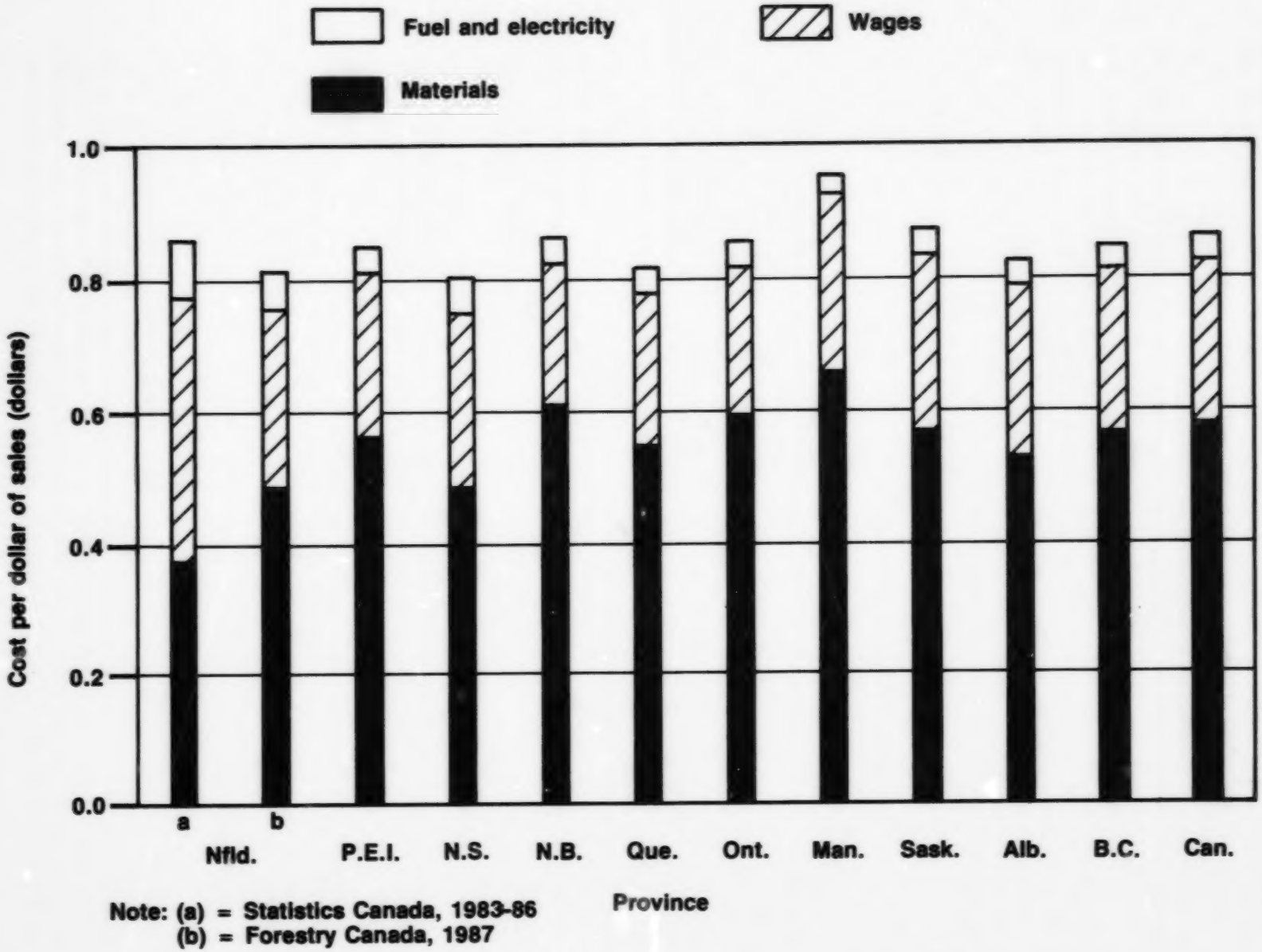
An upper level of production no doubt exists beyond 500 Mfbm at which diseconomies in logging operations become predominate. In the areas of major forestry activity on the mainland, optimum capacity is reached at an annual production of 20 to 30 million fbm (Dobie 1973). In Newfoundland, however, the optimum capacity is substantially less, most likely not exceeding several million fbm annually, because the province's forests yield low volumes of timber per ha. The low volume, small diameter stands tend to be more costly to harvest than high yielding stands. In the past, virtually every sawmill in Newfoundland, which has produced more than several million fbm annually, has experienced financial difficulties, despite often receiving some form of government assistance, because of high costs of acquiring roundwood (Nazir *et al.* 1977).

In conclusion, the optimum size of a sawmill in Newfoundland is clearly greater than 100 Mfbm with some upper limit of perhaps several million fbm. However, less than 7 percent of the sawmills in the province currently operate in this range because the provincial government has favored the smaller, less economically efficient mills (< 100 Mfbm) at the expense of the larger, more economically efficient mills (> 100 Mfbm) when allocating timber.

Stumpage and Economic Rents

Stumpage is the price paid to the owner of forest land by an individual or firm for the right to harvest a given volume of standing timber (Haley 1980). In a competitive market for standing timber and forest products, the volume of stumpage should equal the revenue from the sale of recoverable products and by-products less the total (operating and capital) costs incurred in harvesting and processing, including an allowance for the opportunity cost of capital plus a further allowance for risk (Milne 1986).[1]

[1] As noted previously in this report, the opportunity cost of a factor of production is the return it would earn if employed in its next alternative.



Note: (a) = Statistics Canada, 1983-86
(b) = Forestry Canada, 1987

Figure 5-4 Operating costs: revenue ratios of the sawmill and planing industry of Canada, 1983-87

If stumpage charges are less than the difference between revenue and total costs, the owners of timber would be forgoing income while logging operators and forest product manufacturers would be reaping windfall gains or, as they are referred to by economists, economic rents. On the other hand, if stumpage charges exceed the difference between revenue and costs, prospective purchasers would require a subsidy to encourage them to acquire timber.

The objective of this section is to assess whether stumpage charges on sawlogs harvested on Crown land in Newfoundland, which are set unilaterally by the province in the absence of competitive forces, are approximately equal to the difference between revenue and total costs. To achieve this objective, economic rents are first calculated and then compared to the value of stumpage actually levied by the provincial government.

The approach is similar to that used by Copithorne (1979) and Percy (1986). Economic rent equals value added less the opportunity costs of labor and of capital. The calculation of economic rent is described in greater detail in Appendix G.

Table 5-1 Estimates of economic rent in the sawmill and planing mill industry of Newfoundland, 1987

Stratum	Economic rents
	- $ / Mfbm -
Very small sawmills (1 - 25 Mfbm)	-459.16
Small sawmills (25.1 - 100 Mfbm)	-52.33
Intermediate sawmills (100.1 - 500 Mfbm)	27.35
Large sawmills (> 500 Mfbm)	5.93
Weighted average[a]	-17.86

[a]Weighted by the production of lumber in each stratum

Source: Survey of the operators of sawmills and planing mills in Newfoundland, 1987, Newfoundland and Labrador Regional Office, Forestry Canada.

The results of the estimates of economic rents vary greatly depending on the stratum (Table 5-1). In general, the estimates for each stratum are below the stumpage charges levied by the provincial government on sawlogs harvested on Crown land. In 1987, the provincial government charged either $5.50 or $7.70 per Mfbm of lumber sawn from timber harvested on Crown land depending on whether the timber was accessible or inaccessible by government roads. On the other hand, the average rent, weighted by production, for all sawmills was $ -17.86 per Mfbm. The negative value indicates that most of the owners and operators of local sawmills assign a lower opportunity cost to their capital and labor than has been assumed in this analysis. Furthermore, the negative value suggests that if the provincial government was to raise stumpage charges, marginal mills would become uneconomical. The absence of and, in some cases, negative economic rents is not surprising because of the highly competitive structure of the local industry.

Inter-provincial Performance

The ratio of average operating costs to average revenue in the sawmill and planing mill industry in each province between 1983 and 1986 are presented in Figure 5-4. Average data are used to mitigate the year-to-year variability of the ratios. Only operating costs are presented because Statistics Canada does not publish information on the value of capital employed in all mills in Canada. The operating costs:revenue ratio of mills in Newfoundland, as derived from Forestry Canada's survey, is also included in the figure.

The operating costs:revenue ratios of mills in Newfoundland, regardless of the source of the data, are comparable to those of mills in other provinces. However, the ratios do not provide conclusive evidence of the ability of local mills to compete against mills in other provinces. The ratios are incomplete measures of competitiveness because capital and transfer costs have been omitted.

Technical Efficiency

A method of production is technically efficient if the same output cannot be produced with fewer inputs or, conversely, if for a given level of inputs more output cannot be produced. Technical efficiency is a necessary but not sufficient condition of economic efficiency, the subject of the preceding section. In this section several aspects of productivity, such as the recovery of by-products and use of capital, are discussed.

Recovery of By-products

In the conversion of tapered, cylindrical sawlogs to rectilinear, dressed lumber, by-products, such as slabs, edgings, chips, shavings and sawdust, are inevitably produced. In Newfoundland, these residues provide furnish for the pulp and paper industry, fuel for industrial heating and the generation of thermal electricity, and firewood for domestic heating.

In 1987, the sale of by-products accounted for 3 percent of the total sales of the province's sawmill and planing mill industry, as noted in the first section of this chapter (Figure 5-1). In absolute terms, the sale of by-products totaled $835,660. In general, the sale of by-products increased with output. Whereas the very small mills did not sell by-products, the sale of by-products accounted for 6 percent of the revenue of the large sawmills.

Table 5-2 Average capital employed per mill and total capital of the sawmill and planing mill industry of Newfoundland, 1987

Stratum	Average capital per mill			Total capital		
	Logging operations	Mill	Total	Logging operations	Mill	Total
	- dollars -					
Very small sawmills (1 - 25 Mfbm)	4,562	10,631	15,193	4,908,728	11,439,140	16,347,868
Small sawmills (25.1 - 100 Mfbm)	39,467	76,201	115,668	8,772,210	16,840,386	25,562,596
Intermediate sawmills (100.1 - 500 Mfbm)	111,595	143,645	225,230	9,150,801	11,778,070	20,928,871
Large sawmills (> 500 Mfbm)	294,176	611,693	905,869	3,824,286	7,952,013	11,776,299
Independent planing mills	n.a.	355,316	355,316	n.a.	3,197,840	3,197,840
Weighted average[a] / total	18,991	36,551	55,542	26,606,025	51,207,449	77,813,474
Percent	34	66	100	34	66	100

[a]Weighted by the number of mills in each stratum.

Source: Survey of the operators of sawmills and planing mills in Newfoundland, 1987, Newfoundland and Labrador Regional Office, Forestry Canada.

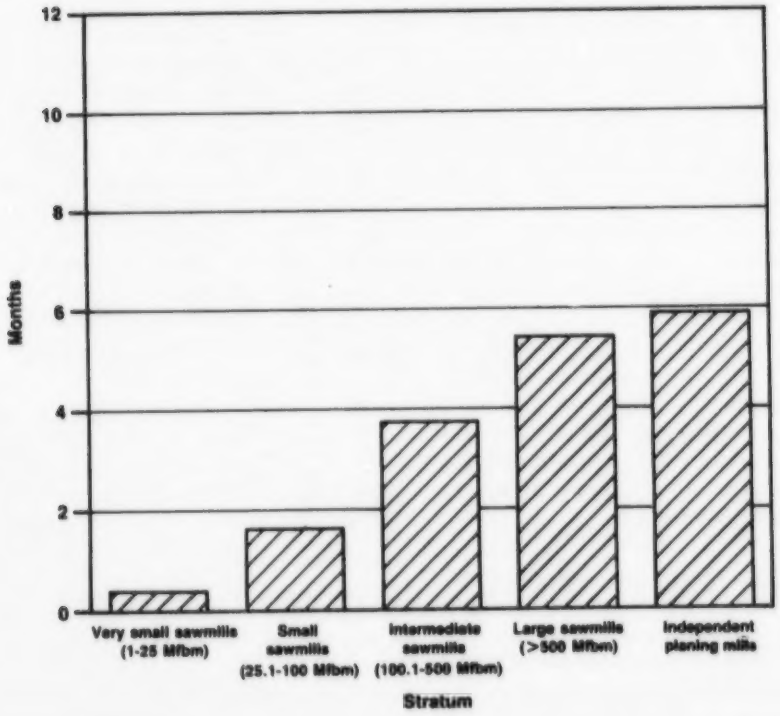


Figure 5-5 Period of operation of sawmills and planing mills in Newfoundland, 1987

The proportion of by-products which are recovered is substantially less in Newfoundland than in most other provinces. For example, the sale of pulpwood chips accounted for less than one percent of the revenue of local sawmills and planing mills in 1987. In comparison, the sale of pulpwood chips accounted for 7, 29, 23 and 22 percent of the revenue of mills in Nova Scotia, New Brunswick, Quebec and Ontario, respectively, in 1986 (Statistics Canada 1989c). Furthermore, most sawmills in Newfoundland use less than 30 percent of each sawlog (Department of Forestry and Agriculture 1989). On the other hand, sawmills in the major forestry regions of Canada use more than 95 percent of each sawlog (Heartwell 1988). Typically, the sawmills of the major forestry regions use 60 percent of a sawlog for lumber, 30 percent for chips and the remainder for hogfuel.

The poor recovery of by-products in Newfoundland is paradoxical. The province's sawmills and planing mills produce proportionally more by-product for a given volume of sawlogs than in most other provinces because local mills use inefficient technology. However, local mills recover proportionally less of their by-products. Numerous reasons exist for the relatively low proportion of by-products which are recovered.

First and foremost, most local sawmills are too small to support the investment required to increase the recovery of by-products (Baird 1990). For example, of the 1,392 sawmills which operated in Newfoundland in 1987, only three large sawmills (> 500 Mfbm) employed a debarker and chipper. In addition, not a single mill used a chipping headrig, so commonly observed on the mainland. Apparently, the vast majority of mills in Newfoundland are not sufficiently large to justify the investment in equipment which is designed to increase the recovery of by-products.

Second, most owners of local mills have few opportunities to sell their by-products. Currently, Abitibi-Price's newsprint mill at Grand Falls is the only major purchaser of by-products from local sawmills and planing mills. In 1987, the mill at Grand Falls purchased 2 584 green tonnes of pulpwood chips and 7 225 green tonnes of planer shavings from nine sawmills and one planer mill (Young 1988). In addition, the newsprint mill purchased 10 350 green tonnes of residues for heating from nine sawmills.

In the foreseeable future, the thermal electrical generating station at Roddickton on the Northern Peninsula is expected to become the only other significant consumer of by-products from sawmills and planing mills in the province. The station is expected to start generating electricity on a full-time basis in mid-1990. It is projected to consume 16 500 green tonnes of sawmill residues, as well as other waste material, annually when operating at full capacity.

The paucity of markets for by-products has lead to low prices. Abitibi-Price's newsprint mill at Grand Falls, a monopsonist in the local market for pulpwood chips, offers suppliers of pulpwood chips a lower price than they would receive in other areas of Atlantic Canada. Currently, sawmill operators in Nova Scotia and New Brunswick receive between $50 and $110 per oven-dried tonne (FOB).[1] In contrast, their counterparts in Newfoundland receive $40 per oven-dried tonne (FOB) (Baird 1990).

Third, many sawmills and planing mills are located in remote regions of the island, far from Abitibi-Price's mill at Grand Falls. As a consequence, these mills are unable to sell their by-products to the newsprint mill because the cost of transportation is prohibitively expensive.

Fourth, the payment of royalties on timber harvested on Crown land encourages the poor use of timber and recovery of by-products. Stumpage is levied on the volume of lumber produced. Therefore, mills have very little incentive to maximize the use of timber in logging operations and the recovery of by-products in the manufacturing of lumber. Instead, stumpage should be levied on the volume of merchantable, standing timber to encourage greater use of timber and recovery of by-products.

In conclusion, the poor recovery of lumber and by-products is a major constraint to the expansion of Newfoundland's sawmill and planing mill industry. As noted previously in this report, the allowable annual cut on Crown land is binding on the island of Newfoundland. If mills on the island are to expand their production and improve their returns in the future, they must increase their recovery of lumber and by-products.

Capital, Seasonal Production and Utilization of Capacity

In 1987, the replacement value of the capital (fixed) employed in local mills totalled nearly $78 million (Table 5-2).[2] Two-thirds of the total capital was employed in the processing of lumber while the remaining one-third was used in logging operations.

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[1] The prices are based on a survey of the seven pulp and paper firms which purchase pulpwood chips from sawmills in the Maritime provinces. The survey was conducted by Forestry Canada's Newfoundland and Labrador Regional Office.

[2] Capital refers to the stock of durable goods such as buildings, vehicles and equipment. A more complete definition of capital is presented on page of this report.

Table 5-4 Proportion of operators of sawmills and planing mills receiving income from other sources in Newfoundland, 1987

Stratum	Proportion of owners earning other income	Most common source of other income
Very small sawmills (1 - 25 Mfbm)	100	Fishing Social assistance and pensions Construction
Small sawmills (25.1 - 100 Mfbm)	55	Social assistance and pensions Fishing Construction
Intermediate sawmills (100.1 - 500 Mfbm)	34	Construction Road building Social assistance and pensions
Large sawmills (> 500 Mfbm)	0	n.a
Independent planing mills	0	n.a
Total	60	Fishing Social assistance and pensions Construction

Source: Survey of the operators of sawmills and planing mills in Newfoundland, 1987, Newfoundland and Labrador Regional Office, Forestry Canada.

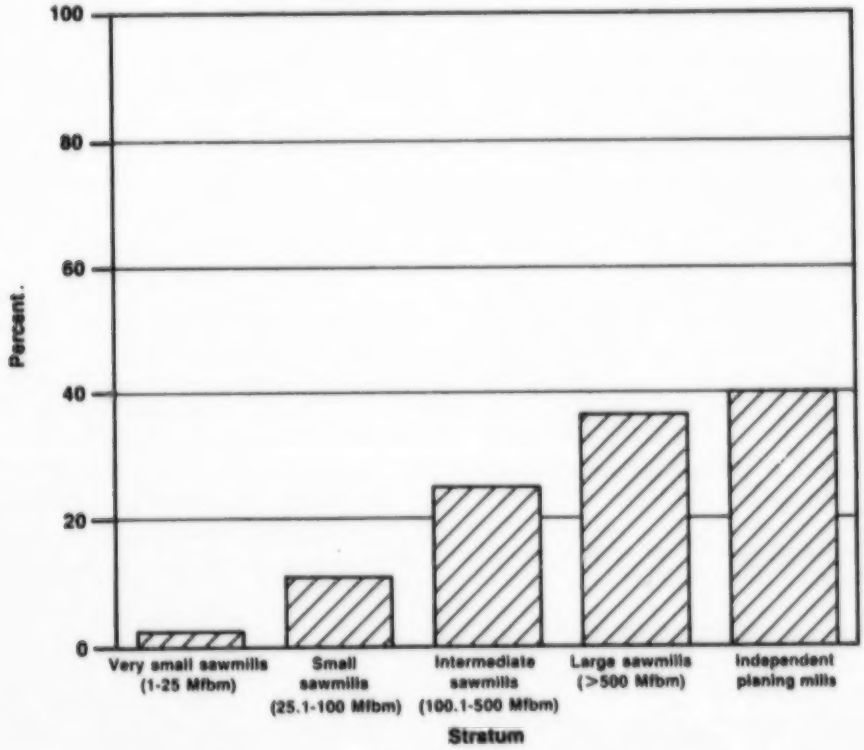

Figure 5-6 Utilized capacity as a percent of potential capacity of sawmill and planing mills in Newfoundland, 1987

Clearly, a positive correlation is evident between the average level of production and average quantity of capital employed in a mill.

Capital:labor ratios are presented in Table 5-3. The ratios measure the value of capital in proportion to person-years of employment. *Prima facia*, the ratios appear to be large suggesting that the production of lumber is capital-intensive. However, closer examination reveals that the ratios are large only because of the pronounced seasonal variation in the production of lumber which has led to excessive employment of capital. On the contrary, the production of lumber is actually labor-intensive in local mills.

Table 5-3 Capital:labor ratios of the sawmill and planing mill industry in Newfoundland, 1987

Stratum	Capital:labor ratios
	— thousand of dollars per person year —
Very small sawmills (1 - 25 Mfbm)	100.5
Small sawmills (25.1 - 100 Mfbm)	93.4
Intermediate sawmills (100.1 - 500 Mfbm)	87.2
Large sawmills (> 500 Mfbm)	75.4
Independent planing mills	59.3
Average	88.5

Source: Survey of the operators of sawmills and planing mills in Newfoundland, 1987, Newfoundland and Labrador Regional Office, Forestry Canada.

In Newfoundland, most sawmills and planing mills operate for only part of the year even during periods of strong demand for lumber. In 1987, the very small sawmills operated for only several weeks on average (Figure 5-5). Typically, the small, intermediate and large sawmills operated for 1.5, 3.7 and 5.5 months, respectively, during the year. Independent planing mills operated for approximately six months on average. Even the very largest sawmills and planing mills rarely operate for more than nine months. Virtually all mills are idle for at least the three winter months. Mills recommence producing lumber in the early spring. The operation of mills climaxes during late spring and early summer, coinciding with the major period of building activity on the island, and then subsides during late summer and fall.

The seasonal variation in the production of lumber is much greater in Newfoundland than in other provinces. Numerous reasons exist for the relatively high seasonal variation in production; four of which are outlined below. First and foremost, the shortage of timber inhibits the operation of the larger mills throughout the year. Second, adverse weather contributes to seasonal production. The climate, especially during the spring thaw, directly affects logging operations which in turn limits the supply of sawlogs to the mills. Third, some operators of mills, in particular the smaller ones, shutdown periodically to pursue other activities, most notably fishing (Table 5-4). The traditional interdependence between the fishery and the sawmill industry still endures especially in the smaller, coastal communities. Fourth, social assistance programs have influenced the seasonal operation of mills. Certainly, the increasing generosity of unemployment insurance has encouraged the intermittent operation of some mills, in particular, those mills with production of less than 100 Mfbm of lumber annually (Table 5-4). In the past several decades, the maximum level of weekly benefits has increased substantially while the period of qualification has declined (Economic Council of Canada 1980).

The seasonal operation of mills adversely affects the productivity of both capital and labor. More capital is required to produce a given quantity of lumber annually in a mill operated on a seasonal basis than in a mill of the same size that operates at a stable level throughout the year. Hence, capital costs per unit of output are higher in the seasonal mill. With regard to labor, workers employed seasonally are less productive because they do not gain as much experience within a given year as those employed year round. Productivity is further reduced in seasonal operations because workers rehired after a period of idleness require time to regain proficiency.

The seasonal production of lumber in Newfoundland has led to the employment of labor-intensive techniques. The owners of local mills operating on a seasonal basis have found it more convenient to hire or dismiss workers as production dictates rather than acquire or sell capital. Capital assets are not readily purchased nor sold to match fluctuations in production. Furthermore, capital costs must be paid regardless of whether the assets are being fully used. As a consequence, owners have favored the adoption of flexible, labor-intensive techniques while spurning rigid, capital-intensive technologies. Unfortunately, the substitution of labor for capital has led to low productivity and poor recovery of lumber and by-products from sawlogs in local mills. Most systems of production in the lumber industry, which are designed to raise productivity and increase recovery, are capital-intensive.

The seasonal variation in production has led to substantial under-utilized capacity in the local lumber industry (Figure 5-6). For example, if Newfoundland's eight largest sawmills operated on a single shift basis for 240 days per year, the output of these eight mills would equal the current, annual production of lumber in the province. These eight mills represent less than one percent of the 1,392 sawmills currently operating in

Table 5-5 Principal statistics of the sawmill and planing mill industry of Newfoundland, 1986 and1987

Source	Period	Number of mills	Production and related workers: Number	Production and related workers: Person years	Production and related workers: Wages	Cost of fuel and electricity	Cost of materials and supplies[a]	Value of shipments	Value added[b]
						– dollars –			
Statistics Canada	1986[c]	40	178	211	2,447,000	641,000	5,726,000	11,054,000	4,599,000
Forestry[d] Canada	1987	521	1,514	514	8,650,483	2,217,109	9,726,945	25,069,400	14,276,019

[a] Includes the cost of purchased wood, but excludes indirect taxes such as crown royalties.

[b] Value added is calculated indirectly at factor costs.

[c] The calendar year 1986 is the most recent period for which principal statistics of the sawmill and planing mill industry of Newfoundland are available from Statistics Canada.

[d] The principal statistics are for commercial mills which operated in Newfoundland in 1987. The domestic mills, numbering 880 in 1987, have been omitted because their lumber was used for personnel use, hence the value of their shipments and, in turn, their value added was zero.

Source: Statistics Canada, Catalogue 25-202, 1989.
Survey of the operators of sawmills and planing mills in Newfoundland, 1987, Newfoundland and Labrador Regional Office, Forestry Canada.

Newfoundland. In other words, 99 percent of the sawmills operating currently in the province could be shutdown permanently if the largest eight sawmills produced at close to their capacity. Clearly, the under-utilized capacity represents an extremely inefficient allocation of resources.

Economic Impact

Numerous indicators exist to measure the impact or importance of an industry to an economy. In this report, three of the most prominent indicators, value added, value of shipments and employment, are used to measure the direct impact of the manufacturing of lumber on the economy of Newfoundland.[1]

Value Added

Value added is the most widely used measure of the economic impact of an industry. It is an industry's net contribution to gross domestic product (GDP).[2]

Value added is measured at either factor costs or market prices (Statistics Canada 1980).[3] Generally, the value added of an industry is measured at factor costs.[4]

Value added at factor costs is calculated either directly or indirectly. The direct approach is to sum the returns (wages, salaries, net operating surplus and depreciation) to the factors of production (hired labor, operators' labor and capital). The indirect approach is to deduct the value of intermediate (purchased) inputs from the value of shipments. Intermediate inputs include fuel, electricity and materials such as purchased roundwood.

Typically, the indirect approach is selected to estimate value added. The indirect approach is usually more precise than the direct approach because in the latter approach the measurement of depreciation poses difficulties.

Using the indirect approach, the value added of Newfoundland's sawmill and planing mill industry was $14.3 million in 1987 (Table 5-5). In contrast, according to information published by Statistics Canada, the value added of the industry was $4.6 million in the preceding year, the most recent for which a comparable datum is available (Table 5-5). The three fold difference between the two values is attributable to Statistics Canada's undercoverage of local mills. As noted previously in this report, Statistics Canada

[1] The indirect and induced effects of the sawmill and planing mill industry, as well as other forest industries, on the economy of Newfoundland will be examined by the Policy, Planning and Economics Section of Forestry Canada's Newfoundland and Labrador Regional Offices in a future study.

[2] Gross domestic product is the sum of the total values added within a specific geographic area, such as a province or a nation, regardless of whether the factors of production are owned by citizens of the area or nonresidents.

[3] Value added at factor costs is the difference between the value of gross output of an industry and the costs of intermediate inputs, such as materials, services and indirect taxes. Value added at market prices is equivalent to value added at factor costs plus indirect taxes less subsidies. Indirect taxes are levied directly on the incomes of factors of production. They include taxes on natural resources such as stumpage. Value added at market prices normally exceeds value added at factor costs because indirect taxes usually exceed subsidies.

[4] The factor cost method is more precise because it excludes indirect taxes which are not a return to the factors of production.

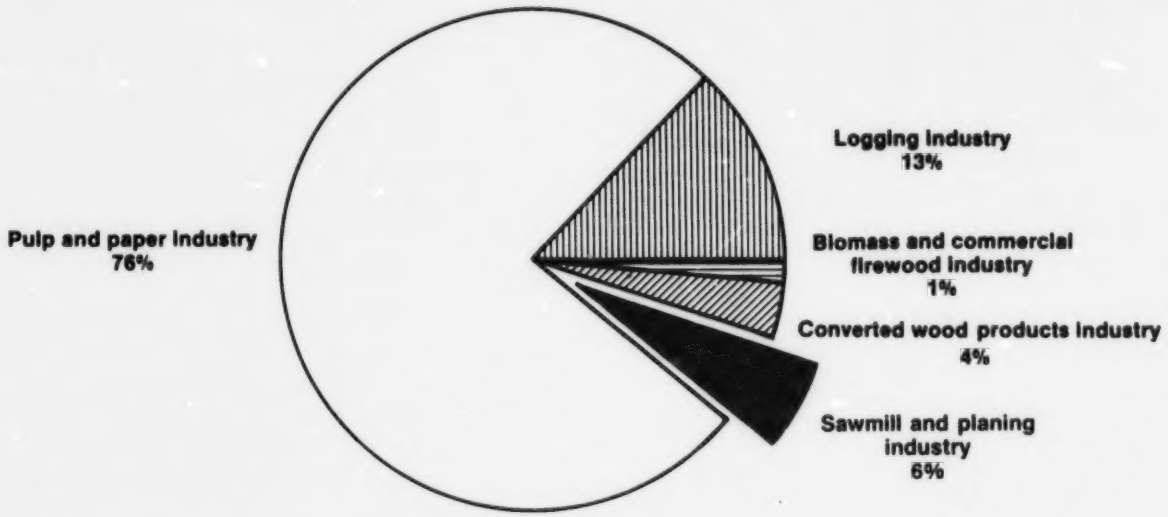

Figure 5-7 Distribution of value added within the forest industry of Newfoundland, 1987

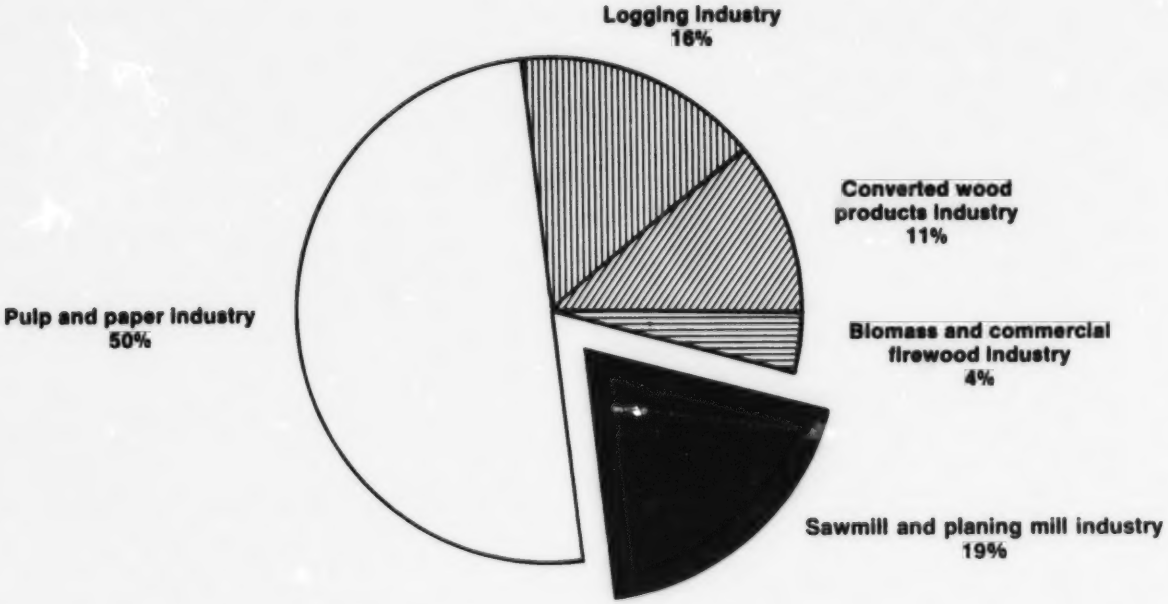

Figure 5-8 Distribution of employment within the forest industry of Newfoundland, 1987

surveys approximately 40 of the largest, commercial mills in the province through its annual *Census ofManufacturers*. However, the census neglects to survey nearly 580 smaller, commercial mills and 880 domestic operations. This pronounced undercoverage by Statistics Canada of a provincial forest industry is not unique (see Heit and Bohning (1988) and Winsor (1990) for further examples).

Value of Shipments

The value of shipments is another important measure of an industry's contribution to an economy. It is defined as the net selling value of goods shipped by an industry (Statistics Canada 1980). The value is net of items such as sales taxes, discounts and transportation expenses.

In 1987, the value of shipments of Newfoundland's sawmill and planing mill industry totalled $25.1 million (Table 5-5). As with value added, the figure is substantially greater than the corresponding figure published by Statistics Canada.

Employment

The direct employment generated by an industry is a very valuable indicator of its importance, especially in Newfoundland. The province has Canada's highest rate of unemployment, in spite of the fact that relatively few Newfoundlanders participate in the labor force.[1]

In 1987, Newfoundland's lumber industry generated 751 person years[2] of direct employment (Table 5-5). Of this total, hired and operators' labor accounted for 514 and 237 person years, respectively. As with value added and value of shipments, the figure exceeds the corresponding figure provided by Statistics Canada. The hired labor figure estimated by Forestry Canada is fifteen times greater than the figure provided by Statistics Canada.

The measurement of employment in person years underestimates the importance of the local sawmill and planing mill industry to the provincial economy because most of its employees work seasonally. An equally important measure of employment is the number of individuals who received at least part of their income from working in local mills. In 1987, 2,112 individuals received part or all of their earned income from direct employment in local mills or associated logging operations.

In conclusion, the public and government officals are often unaware of the importance of Newfoundland's sawmill and planing mill industry because of the obscure location of mills. However, the industry contributes substantially to the provincial economy, especially in rural areas of the province where alternative employment opportunities are scarce. In 1987, the industry shipped $25.1 million of lumber, pulpwood and by-products; contributed $14.3 million to the provincial economy; and provided 751 person years of direct employment, according to data gathered by Forestry Canada. Also, in excess of 2,100 individuals received at least part of their income from working in sawmills or associated logging operations. The economic impact of the industry, as derived from data gathered by Forestry Canada, is far greater than corresponding estimates provided by Statistics Canada.

Relative Economic Impact

The sawmill and planing mill industry is the third largest industry of Newfoundland's forest sector after logging and the manufacturing of newsprint (Table 5-6). In 1987, the industry accounted for 7 percent of the value added and generated 15 percent of the employment in the province's forest sector (Figures 5-7 and 5-8).

Table 5-6 Economic effect of the forest industries on the economy of Newfoundland, 1987

Industry	Value added	Employment
	— millions of dollars —	- person years -
Logging [a]	32.1	655
Biomass and commercial firewood [b]	3.0	165
Sawmill and planing mill [c]	14.3	751
Converted wood products [d]	10.7	448
Pulp and paper [e]	188.1	1,991
Total	248.2	4,010

Source: [a] Unpublished information, Industry Division, Statistics Canada

[b] Northland Associates Ltd., 1988

[c] Survey of the operators of sawmills and planing mills in Newfoundland, 1987, Newfoundland and Labrador Regional Office, Forestry Canada.

[d] Survey of the manufacturers of converted wood products in Newfoundland, 1987, Newfoundland and Labrador Regional Office, Forestry Canada.

[e] Unpublished information, Industry Division, Statistics Canada

[1] For example, the rate of unemployment in Newfoundland was 15.8 percent, twice the national average (Statistics Canada,1989b). However, only 55.7 percent of Newfoundlanders, 15 years of age or older, participated in the work force. In contrast, the national participation rate was 67.0 percent.

2 A person-year is equivalent to an individual working full time for an entire year. It is also equivalent to two individuals working six months each or four

Chapter Summary

Performance has generally been applied to evaluate monopolies and oligopolies rather than predominately competitive industries, such as Newfoundland's lumber industry. Most competitive industries are simply assumed to perform satisfactorily. However, imperfections in the allocation of timber, noted in the analysis of the industry's structure, have impinged upon the overall economic and technical performance of the industry. Generally, the economic and technical performance of the sawmill and planing mill industry of Newfoundland has been poor largely because the provincial government has favored the smaller, less efficient mills (< 100 Mfbm) at the expense of the larger, more efficient mills (> 100 Mfbm) when allocating public timber. This bias has contributed to a sub-optimal allocation of resources. Although the larger mills are significantly more efficient than the smaller operations, they comprise less than 7 percent of the mills in the province.

In 1987, the sawmill and planing mill industry of Newfoundland shipped $25.1 million of lumber, pulpwood and by-products; contributed $14.3 million to the provincial economy; and provided 751 person years of direct employment, according to data gathered by Forestry Canada. Also, in excess of 2,100 individuals received at least part of their income from working in sawmills or associated logging operations. However, the long-term, economic impact of the industry on the economy of Newfoundland could be increased significantly if timber was allocated more efficiently.

CHAPTER VI

CONCLUSIONS AND RECOMMENDATIONS

Without question, the economic and technical performance of the sawmill and planing mill industry of Newfoundland has been unsatisfactory. The performance of the industry can only be improved through the implementation of a clearly articulated provincial program designed to develop the industry. The program should include four measures.

First, stumpage charges should be levied on the volume of merchantable, standing timber to encourage greater use of timber and recovery of by-products. Currently, stumpage charges are levied on the volume of lumber produced. Therefore, mills have little incentive to maximize the use of timber in logging operations and the recovery of by-products in the manufacturing of lumber.

Second, a comprehensive program of technology transfer should be initiated. The program should be targeted at the younger operators of mills to ensure efficient and effective results.

Third, the allocation of timber between the sawmill and planing mill industry and pulp and paper industry should be more highly integrated as is the case in the other areas of eastern Canada. For example, the government of Newfoundland and Labrador could, following the example of the government of Quebec, require that the pulp and paper firms purchase the pulpwood and by-products of local sawmills before purchasing pulpwood from contractors operating on Crown Land (Baird 1990).

Fourth and most importantly, the provincial government should encourage the consolidation of smaller mills into more efficient, larger operations in those areas of the province where the timber resource permits. Simply, the supply of timber is not sufficient to support the number of mills currently operating in Newfoundland (Department of Forest Resources and Lands 1985; Department of Forestry and Agriculture 1989). The consolidation of mills would permit the industry to recover more lumber and by-products from Newfoundland's constrained timber resource. The vast majority of mills currently operating in the province are too small to support the investment in modern technologies, such as debarking and chipping equipment, designed to increase the recovery of lumber and by-products (Baird 1990). As a consequence, most mills recover less than 30 percent of each sawlog far less than their competitors on the mainland (Department of Forestry and Agriculture 1989).

The provincial government, however, will most likely not encourage a restructuring of the industry. Since Confederation, the provincial government has ignored the recommendations of various Royal Commissions and Task Forces to consolidate existing mills into fewer, larger and more efficient operations. For example, the 1955 Royal Commission on Forestry recommended that new licences not be issued to mills (Newfoundland 1955). In addition, the 1973 Federal-Provincial Task Force recommended the "gradual phase out of the push-bench mill as a commercial operation, with quality lumber production being encouraged in larger, more efficient mills" (p. 48, Newfoundland 1973). Instead of heeding these recommendations, the provincial government has permitted the number of small, push-bench mills to double since Confederation.

If the provincial government fails to implement a comprehensive program designed to develop the industry, the future of the industry will be bleak. In the absence of an effective program, many local producers will find it increasingly difficult to compete against mills on the mainland which are generally far more efficient. As a consequence, the returns to the manufacturing of lumber in Newfoundland will dwindle. Eventually, the low returns will force some operators of local mills to seek employment elsewhere and discourage other individuals from entering the industry. Inevitably, the lumber industry on the island of Newfoundland will wither if prompt action is not taken.

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APPENDICES

Appendix A

Sample Survey

A finite population is surveyed by either: (i) a census survey, involving the complete enumeration of all units of a population or (ii) a sample survey, involving the enumeration of a portion of a population (Singh and Chaudary 1986). In this report, sample surveying was selected because the approach is far less expensive and more rapid than a complete enumeration of the total population of operators of mills in the province. The reference period of the sample survey was the 1987 calendar year.

Objectives of the Survey

The primary objective of the survey was to provide the information required to analyse the structure, conduct and performance of the sawmill and planing mill industry of Newfoundland. The survey was also expanded to provide additional information for future studies on the industry to be conducted by employees of the Policy, Planning and Economics Section of Forestry Canada's Newfoundland and Labrador Regional Office.

Definition of the Population

The population from which the sample was drawn comprised of all licensed sawmills and planing mills which operated in Newfoundland in 1987. Licensed sawmills which did not operate or failed to file a return for 1987 and unlicensed sawmills were excluded from the population.

The population of sawmills and planing mills was divided into two groups. The first group comprised of sawmills which manufacture lumber from roundwood and may or may not also plane lumber. The second group comprised of independent planing mills. Planing mills resaw and plane squares or rough lumber previously sawn by other mills. In this report, establishments were classified as planing mills if 90 percent or more of their wood requirements were fulfilled by lumber or squares previously sawn by other mills. The vast majority of the mills in the province belong to the first group. Very few mills predominately resaw squares or plane lumber previously sawn by other mills.

Determination of the Sampling Frame

The sampling frame comprised of a list of sawmills and planing mills which operated in Newfoundland in 1987. The sawmills were readily identified from the records of sawmill licence holders compiled by the provincial government's Department of Forestry and Agriculture (DFA) for the 1987 fiscal year, the most recent period for which this information was available.[1]

The identification of independent planing mills was far more difficult. The DFA does not record information on mills which predominately resaw squares or plane lumber previously sawn by other mills. As a consequence, independent planing mills were identified with the help of the Newfoundland Lumber Producers' Association. Whereas the identification of sawmills was complete, accurate and up-to-date, one or two planing mills may have been omitted from the sampling frame. However, the effects of an omission would not have been serious because independent planing mills comprise less than one percent of the total number of mills in the province.

Selection of Sampling Design

The simplest and most common methods of sampling are: (i) simple random sampling and (ii) stratified random sampling (Singh and Chaudhary 1986). In this report, the method of stratified random sampling was selected.[2] Stratified random sampling involves the division or stratification of a population into relatively homogenous groups, referred to as strata, and the independent selection of random samples in each stratum.

The method of stratified random sampling was selected for two reasons. First, the method permitted the use of different survey techniques in different strata. The very small mills, producing less than or equal to 25 thousand board feet (Mfbm) of lumber annually, and all mills in Labrador, regardless of size, were surveyed by a self-administered questionnaire sent and returned by mail. On the other hand, the sawmills, producing more than 25 Mfbm of lumber annually, and planing mills on the island of Newfoundland were surveyed through a questionnaire completed during a personal interview. The completion of a questionnaire through a personal interview was preferred to a self-administered questionnaire because, in general, a personal interview reduces non-sampling errors and encourages greater participation than a self-administered questionnaire.[3] However, not all the sampled mills could be surveyed through a personal interview because of insufficient funds.

[1] The DFA complies records of licensed sawmills for the fiscal year, covering the period from 1 April to 31 March of the folllowing year. However, the fiscal year is not distinguished from the calendar year when the DFA's records are referred to throughout this report because mills in Newfoundland are largely inactive during January, February and March.

[2] The random sampling was conducted without replacement.

[3] Sampling errors are attributable to surveying a portion of a population rather than conducting a census of the total population (Satin and Shatsny 1983). On the other hand, non-sampling errors are present in both sample surveys and censuses. They arise because of myraid factors such as the incorrect recording of information of misinterpretation of a question by a respondent (Singh and Chaudhary 1986).

Therefore, only the larger sawmills and planing mills on the island were surveyed personally. Any loss of precision in the estimated parameters of the mills surveyed by a self-administered questionnaire is mitigated by their relatively insignificant share, less than 15 percent, of the total production of lumber in the province.[1]

Second and more importantly, stratification was desired because it produces greater precision in the estimated parameters for a heterogeneous population than simple random sampling or any other sampling technique (Cochran 1977; Singh and Chaudhary 1986). The population of sawmills and planing mills in Newfoundland is heterogeneous. A few very large mills produce the majority of lumber while numerous smaller mills produce only minimal quantities of lumber. Stratifying mills into relatively homogenous groups according to their level of production allowed the larger mills to be more thoroughly surveyed and, hence, properly represented in the sample.

Formation of the Strata

In general, a population may be stratified by any number of characteristics. In this report, the population of sawmills was stratified into four mutually exclusive strata according to each mill's production of lumber in 1987, as derived from the records of licensed sawmills compiled by the DFA. The fifth strata was comprised of independent planing mills. The five strata are:

(i) *very small* sawmills, annual lumber production of 25 thousand board feet (Mfbm) or less;

(ii) *small* sawmills, annual lumber production of greater than 25 Mfbm and less than or equal to 100 Mfbm;

(iii) *medium* sawmills, annual lumber production of greater than 100 Mfbm and less than or equal to 500 Mfbm;

(iv) *large* sawmills, annual lumber production of greater than 500 Mfbm; and

(v) *independent* planing mills.

The mills of the large stratum are considered large only by local standards. The largest sawmill in Newfoundland would tend to be small relative to those located in most other provinces. For example, the largest mill in Newfoundland produced 4 million fbm of lumber in 1987. In contrast, the largest mill in Canada, the Rustad Brothers' mill in Prince George, British Columbia, produced 217 million fbm of lumber in 1988 (Canadian Forest Industries 1989), more than four times the total production of lumber in Newfoundland. The largest mill in the Maritime provinces, J.D. Irving's new mill at St. Leonard's, New Brunswick, is expected to produce 100 million fbm annually.

Allocation of Sample Size in the Different Strata

Numerous methods exist to allocate sample sizes to different strata in a stratified sampling procedure. Four of the most frequently applied methods are equal, proportional, disproportional and optimum allocation (Cochran 1977). In this report, a special case of optimum allocation, commonly referred to as the Neyman method of allocation, was used as a guide to determine the sample size in each of the five strata.

According to the Neyman method of allocation, the size of samples are increased in those strata in which the variance and the number of observations are relatively large. The allocation of samples in the ith stratum is given by

$$n_i = n \frac{W_i S_i}{\sum_{i=1}^{n} W_i S_i}$$

where n_i is the sample size in the ith stratum, n is the total of the sample, W_i is the stratum weight relative to the population, and S_i is the standard deviation of a characteristic of the ith stratum.

To apply the Neyman method of allocation, accurate information on a characteristic of the population, from which the variances are estimated, is required. The annual production of lumber recorded by the DFA was selected as the population characteristic in this report. Although the production of lumber recorded by the DFA is generally less than actual production, it is still considered sufficiently accurate.

As noted above, the Neyman method of allocation was used only as a guide. In most strata more mills were sampled than suggested by the allocation method because some operators of sampled mills were expected to decline to participate in the survey.

The response rate for the very small mills, which were surveyed by mail, was anticipated to be lower than the mills surveyed personally; therefore, the number of mills sampled in this stratum was higher than the other strata (third column, Table A-1)

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[1]Precision refers to the difference between an estimate of a parameter from a sample survey and the result that would have been obtained from a 100 percent enumeration of the population (Satin and Shastry 1983).

Table A-1 Results of the stratified sample survey of sawmills and planing mills in Newfoundland, 1987

Stratum	Number of mills	Number of of mills surveyed	Number of completed questionnaires	Effective rate of response	Proportion of population surveyed
	a	b	c	(c/b x 100)	(c/a x 100)
				— percent —	
Very small mills (1 - 25 Mfbm)	1,076	538	126	23	12
Small sawmills (25.1 - 100 Mfbm)	221	110	83	75	38
Intermediate sawmills (100.1 - 500 Mfbm)	82	82	50	61	61
Large sawmills (> 500 Mfbm)	13	13	12	92	92
Independent planing mills	9	9	9	100	100
Total	1,401	752	280	37	20

Source: Survey of the operators of sawmills and planing mills in Newfoundland, 1987, Newfoundland and Labrador Regional Office, Forestry Canada

Development and Pretesting of the Questionnaire

A questionnaire used in a previous survey of sawmills and planing mills in Newfoundland conducted in 1981 was updated and augmented with several additional questions (Milne 1984). The questionnaire was then pretested in cooperation with the operators of several sawmills and independent planing mills of various sizes on the Bonavista Peninsula. The pretesting resulted in slight modifications of the questionnaire. After the modifications were completed, the questionnaire was translated into French in accordance with the federal government's official language requirements.[1]

Organization of the Field Work

Interviewers were hired to survey the operators of sawmills, producing more than 25 Mfbm, and planing mills on the island of Newfoundland. The interviewers were thoroughly trained in the statistical aspects of surveying and in the art of eliciting information from the operators of mills prior to conducting the field work. The field work was conducted during the summer of 1988. The operators surveyed by mail were sent a questionnaire similar to the one used during the personal interviews.

Analysis of the Data

Completed questionnaires were scrutinized and edited to amend recording errors. Respondents were telephoned to complete omitted answers and correct inconsistent information. The confidentiality of the data provided by the respondents was assured throughout the survey process. A computer analyst was hired to encode the information from the completed questionnaires into a database. The database was analyzed using the statistical software SAS.

Results of the Survey

Generally, the response of the operators of mills was greater than expected. In total, the operators of 271 sawmills and nine planing mills completed questionnaires (Table A-1). These 280 mills accounted for 20 percent of the population of sawmills and planing mills in the province.

The operators of all nine planing mills participated in the survey. The operators of 12 of the 13 large sawmills also completed questionnaires. The sole large sawmill which did not participate in the survey was in receivership for part of 1987; as a consequence, the operator of the mill declined to participate in the survey.

Of the 280 mills surveyed, one intermediate sawmill in Labrador and 126 very small sawmills on the island and in Labrador were surveyed by a self-administered questionnaire sent and returned by mail. In total, 153 mills on the island were surveyed during a personal interview.

[1] A copy of the questionnaire in either French or English is available upon request from the author.

Appendix B

A Spatial Equilibrium Model of the Demand for and Supply of Lumber in Newfoundland and the Mainland of Canada.

In this appendix, a simple, spatial model involving two regions, Newfoundland and the mainland of Canada, is outlined.

The equilibrium solution is,

(1) $Q_{sn} = \alpha + \beta (P_n)$

(2) $Q_{sm} = \alpha + \beta (P_n - T)$

and total demand equals total supply in the two regions,

(3) $Q_{dn} + Q_{dm} = Q_{sn} + Q_{sm}$

where Q_{dn} and Q_{dm} represent the quantities of lumber demanded in Newfoundland and on the mainland, respectively; Q_{sn} and Q_{sm} represent the quantities of lumber supplied in Newfoundland and on the mainland, respectively; P_n represents the equilibrium price in Newfoundland with trade; T represents the cost of transferring lumber between the Canadian mainland and Newfoundland; and P_n-T equals the equilibrium price on the mainland with trade.

In the above model α, β, T, Q_{dn} and Q_{dm} are assumed to be known. The unknowns or endogenous variables are P_n, Q_{sn} and Q_{sm}.

The solution, solving in terms of the unknown variables, P_n, Q_{sn} and Q_{sm}, is,

(a) add equations (1) and (2)

$$Q_{sn} + Q_{sm} = 2\alpha + 2\beta P_n - \beta T$$

(b) from equation (3)

$$Q_{dn} + Q_{dm} = 2\alpha + 2\beta P_n - \beta T$$

(c) solving for the equilibrium price

$$P_n = \frac{1}{2\beta} (Q_{dn} + Q_{dm} - 2\alpha + \beta T)$$

Therefore, an increase in Q_{dn}, Q_{dm} or T, other things remaining the same, will result in a higher price of lumber in Newfoundland. For example, the introduction of the goods and services tax (GST) will raise the cost of transferring lumber to Newfoundland which, in turn, will increase the price of lumber in the province.

(d) equations (1) and (2) can be used to solved for Q_{sn} and Q_{sm}

$$Q_{sn} = 1/2(Q_{dn} + Q_{dm} + \beta T)$$

$$Q_{sm} = 1/2(Q_{dn} + Q_{dm} - \beta T)$$

Therefore, increasing Q_{dn} and Q_{dm}, *ceteris paribus*, will expand the production of lumber in both regions. In contrast, increasing T, transfer costs, will expand the production of lumber in Newfoundland at the expense of production on the mainland.

Appendix C

Table C-1 Production, imports and total consumption of lumber in Newfoundland, 1967 - 88

Year	Lumber produced in Newfoundland	Lumber imported into Newfoundland	Lumber consumed in Newfoundland	Nfld's share of the province's consumption
	a	b	c	(a/c) x 100
		- Mfbm -		- percent -
1967	28,700	52,100	80,800	36
1968	25,100	44,800	69,900	36
1969	27,100	42,600	69,700	39
1970	34,700	33,800	68,500	51
1971	31,200	58,500	89,700	35
1972	30,600	61,800	92,400	33
1973	49,100	49,100	98,500	50
1974	43,100	66,400	109,500	39
1975	28,600	75,500	104,100	27
1976	37,200	58,000	95,200	39
1977	42,500	53,700	96,200	44
1978	48,700	43,500	92,200	53
1979	48,800	42,300	91,100	54
1980	39,200	48,000	87,200	45
1981	33,400	36,100	69,500	48
1982	32,800	41,300	74,100	44
1983	37,800	50,500	88,300	43
1984	38,300	49,700	88,000	44
1985	44,300	52,900	97,200	46
1986	45,500	56,800	102,300	44
1987	47,400	76,900	124,300	38
1988	49,300	86,900	136,100	36
Average	38,300	53,700	92,036	42
Coefficient of variation, 1967-88	21	25	19	16

Source: Lumber produced in Newfoundland:
1967-88, Department of Forestry and Agriculture
Lumber imported into Newfoundland:
1967-78, Canadian National and Clarke Steamships, collected by the Maritime Lumber Bureau and reported by Munro (Department of Forestry and Agriculture 1978);
1979-83, Hayden (1986);
1984-85, estimates are based on a survey conducted by Berry (1987)
1986-88, Survey of lumber importers in Newfoundland, 1989, Newfoundland and Labrador Regional Office, Forestry Canada.

Appendix D

Table D-1 Price of rough and dressed lumber, Newfoundland, 1977-87

Year	Price of rough lumber	Price of dressed lumber	Difference between rough and dressed lumber prices
	— dollars per thousand board feet —		— percent —
1977	150	210	40
1978	163	225	38
1979	181	247	36
1980	202	283	40
1981	170	235	38
1982	182	250	37
1983	209	304	46
1984	215	305	42
1985	224	317	42
1986	233	327	40
1987	243	332	37
Average, 1977-87	197	276	40
Coefficient of variation, 1967-88	15	15	7

Source: 1977-83, Milne (1984)
1983-87, Survey of the operators of sawmills and planing mills in Newfoundland, 1987, Newfoundland and Labrador Regional Office, Forestry Canada.

Appendix E

Table E-1 Lumber production by size of sawmill, Newfoundland, 1975-87[a]

	Very small and small[b] (less than 100 Mfbm/yr.)		Intermediate (100.1 to 500 Mfbm/yr.)		Large (over 500 Mfbm/yr.)		
	Annual Production	Proportion of Total	Annual Production	Proportion of Total	Annual Production	Proportion of Total	Total Production
	- Mfbm -	- percent -	- Mfbm -	- percent -	- Mfbm -	- percent -	- Mfbm -
1975	12,600	44	10,900	38	5,100	18	28,600
1976	15,200	40	13,300	36	9,000	24	37,500
1977	17,100	40	13,400	32	12,000	28	42,500
1978	16,500	34	15,500	32	16,700	34	48,700
1979	16,900	35	15,800	32	16,100	33	48,800
1980	18,000	46	13,300	34	8,000	20	39,300
1981	17,000	51	10,900	33	5,400	16	33,300
1982	17,100	52	11,300	34	4,400	14	32,800
1983	18,200	48	12,200	32	7,500	20	37,900
1984	18,900	49	15,200	40	4,300	11	38,400
1985	20,300	46	18,600	42	5,400	12	44,300
1986	19,000	42	15,800	35	10,600	23	45,400
1987	17,700	37	15,400	33	14,400	30	47,500
Average 1975-88	17,300	42	14,000	35	9,000	20	40,400
Coefficient of variation	11	-	17	-	49	-	16

[a] Annual values of lumber production have been rounded to the nearest centisemal.
[b] Unfortunately, the only records available prior to 1979 combined the production of very small and small sawmills into a single group.
Source: Department of Forestry and Agriculture, Government of Newfoundland and Labrador, 1975-87.

Appendix F

Calculation of the Cost of Capital

The cost of capital services, C, is calculated as:

$$C = r(K_1 + K_2 + K_3) + d_1K_1 + d_2K_2 + d_3K_3$$

where K_1,K_2 and K_3 are the replacement value of buildings, equipment and vehicles, respectively; r is the expected, real rate of return to capital used in the manufacturing of lumber; and d_1, d_2 and d_3 are the rates of depreciation of buildings, equipment and vehicles, respectively. Depreciation is defined as the reduction in the value of capital through physical wear and tear. The rates of depreciation of buildings, vehicles and equipment are assumed to equal 2.5, 5 and 5 percent respectively. Conservative rates of depreciation are selected to reflect the typically aged condition of the capital employed in local mills. The depreciation of vehicles and equipment is adjusted to reflect those periods during the year when mills are idle (Williamson 1983).

An approximation of the real, rate of return to capital is drawn from a very useful study by Peprah (1984). The author estimated the private, after-tax rates of return adjusted for economic depreciation and inflation to various economic activities, including the wood industries, in Canada between 1965-81. His estimate of a 5.7 percent real, rate of return to the wood industries is selected as an approximation of the rate of return to capital in local mills.

Appendix G

Calculation of Economic Rent

Economic rent equals value added minus the opportunity cost of labor and cost of capital services. Value added is equal to the value of shipments less the costs of intermediate inputs, including fuel and purchased roundwood but excluding crown royalties.

Opportunity cost of labor

A wide range of possibilities exist from which the opportunity cost of labor may be selected. The range is bounded on the upper extreme by the average manufacturing wage and on the lower extreme by the legislated minimum wage. In 1986, the latest year for which information is available, the average manufacturing wage in Newfoundland was $9.54 per hour (Statistics Canada 1989b). However, the wage appears to be an unrealistically high measure of labor's opportunity cost because employment opportunities in the province's few manufacturing industries are scarce. If an individual is not employed by a local sawmill or planing mill, it is unclear whether he or she would be able to find alternative employment in another manufacturing industry within the province. On the other hand, the minimum wage, which was $4.00 per hour in 1987, is an unrealistically low measure of the opportunity cost of labor. Few Newfoundlanders are willing to work for the minimum wage. Frequently, jobs offered at the minimum wage remain unfilled for extended periods.

For the following analysis, a mid-point between the manufacturing and minimum wage is selected as an approximation of the opportunity cost of labor. In 1987, the mid-point between the two wages was $6.77 per hour.

Cost of capital services

The cost of capital services is calculated as in the previous appendix. The average yield on corporate, long-term bonds from 1968 to 1987 is used as an approximation of the nominal, opportunity cost of capital (Series B14016, 1968-78; Series B14048, 1979-87, Bank of Canada). A two percent premium is added to the bond yield to reflect risk (Percy 1986). The resulting value is then converted from nominal to real terms using the implicit price index for business investment in capital (Statistics Canada various issues).